The Journal of Thoracic Surgery

VOL. II FEBRUARY, 1933 NO. 3

Original Communications

EXPERIENCES WITH CARCINOMA OF THE ESOPHAGUS*

CARL EGGERS, M.D.
NEW YORK CITY

AT a recent meeting, after the presentation of a patient with carcinoma of the esophagus who had reacted rather well to treatment with radium, an endoscopist remarked rather cynically, "It seems to me that this method should be tried much more thoroughly and systematically, for it offers the patient more than surgery, it offers relief and prolongation of life, while surgery relieves the patient, but at the cost of terminating his life."

This statement prompted me to investigate what has been accomplished by means of surgery and on the basis of my own cases try to determine whether there are any possibilities for improving results.

There is no question that at the present time there is an attitude of pessimism among all branches of the medical profession concerning the treatment of carcinoma of the esophagus. There is also no question that this attitude is justified, for the results have been bad. As progressive medical men, however, we should not be satisfied with this condition, we should find ways and means to conquer the disease. Perhaps by facing the facts, and by studying the reasons for failure, we may gradually improve diagnostic and therapeutic measures to such a point that it will be possible to save a larger number of patients and thereby establish some degree of confidence.

It is a common experience of every surgeon who has attempted esophageal surgery that the condition is inoperable when the patient first comes

*From the Lenox Hill Hospital, New York City.
Read at the Fifteenth Annual Meeting of the American Association for Thoracic Surgery at Ann Arbor, Michigan, April 18, 19, 20, 1932.

under observation. Largely as a result of this alone, the great majority of patients with carcinoma of the esophagus have to be rejected for radical operation. When one, in addition to that, considers that the patients are usually of advanced age, and that they frequently have complications, such as emphysema, bronchitis, myocarditis, nephritis, or arteriosclerosis, the group of patients who may be subjected to such a formidable procedure as resection of the esophagus, becomes a very small one.

In spite of all the dangers, however, and in the face of great technical difficulties, portions of the esophagus have been successfully removed and the patients have lived sufficiently long to demonstrate that the operation is technically feasible and that they may be completely cured.

Although I have seen many patients with carcinoma of the esophagus, both at the hospital and in consultation, most of them had to be rejected for operative interference. They either were in such an emaciated condition after everything else had been tried, that there was no hope for them, or they had complications in other organs which made them very poor surgical risks. For many patients a palliative gastrostomy was done, others were referred for radium or x-ray treatment. Only a very small group remained who either were in sufficiently good condition, or could be put into sufficiently good condition, to warrant an exploratory operation, and in whom an actual attempt was made to remove the tumor.

There were 17 cases in all; in 5 the upper end of the esophagus was affected, in 9 the thoracic portion, and in 3 the region of the cardia.

Difficulty in swallowing was the chief symptom in all, frequently associated with pain.

I. CARCINOMA OF UPPER END OF THE ESOPHAGUS

Of the 5 patients in this group 3 were under forty years of age, one fifty, and one sixty-nine.

There were 3 women and 2 men.

In all the patients symptoms had been present a long time, six months, nine months, twelve months, fourteen months, and several years. In 2 patients there were palpable metastatic cervical lymph nodes. In spite of that it was possible to remove the tumor in all cases.

Whether the tumors arose in the esophagus, or in the hypopharynx, it was not possible to state. At the time of operation all of them involved the upper end of the esophagus, the hypopharynx, and in 3 patients also the larynx.

It has appeared to us that in all such cases complete extirpation of the upper end of the esophagus, pharynx, and larynx with associated lymph nodes, is the procedure of choice. It insures thorough removal of affected tissues with a chance for permanent cure. The tracheotomy remains permanently, but the pharynx may be reconstructed later by the method advocated by Gluck, with more or less successful deglutition.

Of the 5 patients 3 died soon after operation, 1 apparently from infection or pneumonia three days after operation, and the other two, three, and ten days postoperative respectively, apparently due to general exhaustion and emaciation. Two patients recovered from the operation and lived four and a half and five months respectively, when they succumbed, apparently both due to metastases.

The long history of difficulty in swallowing and the resultant state of emaciation and dehydration made all of these cases poor risks for such extensive procedures. That in spite of these conditions two recovered makes one feel hopeful that earlier cases may be cured.

CASE 1.—W. F., sixty-nine years of age, admitted April 8, 1924.

Had feeling of discomfort and pressure in throat for several years. Regurgitation of food at irregular intervals. Acute increase in symptoms for four weeks. Weakness.

He did not consult a physician until four weeks before admission. Had painful swallowing, but was able to eat all kinds of food. He was referred to a surgeon at once.

Examination of the neck was negative except for hard lymph nodes on the left side of the neck, along the anterior border of the sternocleidomastoid muscle, suspicious of carcinoma. A Wassermann test was negative.

Esophagoscopy and pharyngoscopy showed a flat ulcerating growth on the posterior wall of the hypopharynx and extending down into the esophagus. It was vascular and friable.

He probably had a slowly growing tumor for several years and only when it involved the esophagus and lymph nodes did it cause serious symptoms and interfere with nutrition.

April 19, 1924, operation was performed under colonic ether anesthesia.

A five-inch incision was made along the anterior border of the left sternocleidomastoid muscle. Entire chain of glands removed. Superior and inferior thyroid vessels and omohyoid muscle divided and larynx rotated to opposite side. Pharynx separated from spinal column and even then it was not possible to feel the tumor through the constrictor muscles. Pharynx opened in left posterolateral aspect, and it was found that the incision went directly through the tumor, which was about ¼ inch thick and spread out very extensively over the pharynx, into the esophagus, onto the lateral wall of the pharynx, and then upward on the posterior and left lateral walls. The esophagus was divided and sutured to the lower margin of the skin wound. The entire affected portion of the pharynx was then removed, leaving only a small portion of normal tissue. The lesion was much more extensive than had been anticipated and the operation therefore was one of great magnitude. A stomach tube was inserted into the upper end of the esophagus down into the stomach. An iodoform tampon was placed behind the esophagus to prevent spreading of infection downward. Several iodoform tampons were placed into the pharynx, leaving free air passage between the mouth and larynx. Wound partly closed.

Temperature rose to 103.4° F. and patient died on April 22, 1924, three days after operation.

Pathologic examination revealed a squamous cell epithelioma of hypopharynx and esophagus, with lymph node involvement.

An autopsy was performed and no secondary tumors were found.

This patient had been promptly advised to seek surgical relief. He should have consulted a doctor earlier. It was probably primarily a hypo-

pharynx tumor and secondarily involved the esophagus. He was a bad risk from the beginning, since he was an old man of sixty-nine years, and the glands were involved.

CASE 2.—P. G., thirty years of age, admitted August 1, 1924.

This patient had a radical operation done for carcinoma of the upper end of the esophagus and the hypopharynx on August 12, 1924. The larynx was removed. A gastrostomy had been done.

This patient was presented as a healed case before the New York Surgical Society, November 12, 1924, and the case report was subsequently published with the Transactions in *Annals of Surgery* **81**: 695, 1925.

The patient was pregnant at the time of operation and it was our intention to attempt reconstruction of the pharynx from the skin of the neck after her confinement.

Unfortunately, she developed a metastatic tumor in the thyroid gland which rapidly increased in size. The possibility of interrupting her pregnancy was discussed but advised against by her obstetrician. X-ray treatments were given, which broke down the tumor.

On December 12, 1924, she was delivered of a normal female child. The fluctuating tumor was incised during her stay in the hospital and broken down tumor and pus were evacuated. It was reported epithelioma. The wound never healed entirely.

During the night of January 21, 1925, the patient suddenly had a hemorrhage from this wound, probably due to erosion of a vessel, and died of aspiration of her own blood into the tracheotomy opening.

In this case it might have been well to interrupt the pregnancy as soon as carcinoma was diagnosed, because of the known rapid growth of malignant tumors during that period.

CASE 3.—A. M., thirty-seven years of age, admitted January 14, 1925.

Difficulty in swallowing for one year. Patient was sent to us from another hospital where x-ray study had shown a growth of the upper esophagus, and a biopsy of the growth had been diagnosed as squamous cell epithelioma. A gastrostomy had been performed, and he had received all his food by that route.

He was an emaciated, sickly looking man. His normal weight was 118 pounds, present weight 96 pounds. He had no pain. His only symptom was difficulty in swallowing. There was no tumor palpable in the neck but there was a large, hard, lymph node present on the right side, just below the lobule of the ear, and a hard strand of lymphatic tissue extending downward from there to the region below the larynx. X-ray of the chest was negative for metastases.

A radical operation in two stages was decided on and on January 20, 1925, the first stage was done under colonic anesthesia.

A transverse incision was made at the level of the hyoid, another one above the clavicles, both united by a median vertical incision. The two flaps were dissected back and muscles divided, except the sternocleidomastoid muscles which were retracted. The entire right cervical chains of lymph nodes, both superficial and deep, were removed, as well as the right lobe of the thyroid gland. The operation was very difficult. Larynx, pharynx, esophagus, and trachea were dissected free, so that these structures were completely separated from the spinal column. Palpation was difficult and unsatisfactory, but it could be made out that the tumor extended from the upper end of the esophagus into the hypopharynx. Its upper limit could not be determined. Gauze was packed around the various structures to form adhesions and protect the mediastinum. Wound then completely closed.

January 29, 1925, second stage under colonic anesthesia, for removal of larynx, pharynx, and upper end of esophagus. Old incision reopened, gauze strips removed.

All portions of wound were clean and bled easily. The trachea was divided between the second and third rings and brought forward and sutured into place just above the sternum. The esophagus was then divided below the tumor, giving a fairly safe margin. This left a short stump difficult to hold up. It was sutured to the skin with considerable tension. Ends were left long. Larynx and pharynx were then turned upward after packing them with gauze, and completely liberated. Thyrohyoid membrane divided and it was then found that the tumor extended above this level, so that the hyoid bone also had to be taken away right to the base of the tongue. Posterior wall also extensively involved, so that only a very short pharyngeal stump remained which was sutured to the skin margin. Flaps were united in median line. Adequate drainage established.

After his second operation the patient did very well at first, in spite of the fact that he was very much emaciated. Adequate food was given. Gradually, however, the suture began to cut through and the wound took on unhealthy sloughy appearance, without any actual acute infection being present. In spite of frequent dressings and good care the patient gradually lost ground and finally expired eleven days after the first operation, probably from exhaustion. There was no evidence of a mediastinitis or pulmonary infection.

The pathologic report was squamous cell epithelioma of esophagus, pharynx, and lymph nodes.

This patient probably would have done all right if he had been operated upon before he had metastatic lymph node involvement and before he was so emaciated.

Case 4.—F. M., thirty-six years of age, admitted January 29, 1925.

Patient complained of difficulty in swallowing for nine months and loss of weight.

She was referred to us from another hospital at which a diagnosis of epithelioma of the esophagus and hypopharynx had been made. On account of the inability to swallow, a gastrostomy had been done before she came to us. Her weight was 87¼ pounds. The diagnosis of epithelioma and the location of the tumor were verified. Examination of the neck was negative. The problem was, what to do for the patient.

An operation in two stages was decided on, and the first stage was done February 16, 1925, under colonic ether anesthesia. The procedure was similar to that used in the previous cases. A pharyngoscopic examination made during the operation definitely established that the larynx was not involved, and it was therefore decided not to sacrifice it. The mobilization was therefore less complete than in the other cases and confined more to the left side where it was expected to enter the esophagus and pharynx later.

The patient reacted well from the operation.

February 25, 1925, second stage of operation in which wound of last operation was reopened. Gauze strips were removed. By means of artery clamps attached to the left lateral wall of the larynx, it was rotated to the right, partly exposing the posterior wall of the pharynx and esophagus. The esophagus was opened by a left lateral incision and with a finger and light as a guide the incision was enlarged upward into the pharynx, and continued around the tumor. Owing to the narrow space this was rather difficult until the upper margin was reached which was close to the right cornu of the larynx. The larynx itself was not involved, but owing to its pressure the technical removal of the tumor was very difficult and the impression was gained that in similar cases removal of the larynx would make it possible to do a more thorough radical operation. The tumor apparently occupied the posterior wall of the esophagus and hypopharynx and extended over onto the lateral wall, especially on the right side. There was a moderate amount of bleeding which was controlled by gauze pressure.

The immediate postoperative course was quite uneventful. The tampons were gradually removed and the wound healed by primary union. The neck tube into the upper end of the esophagus was continued for a long time as a safety valve and guide to the esophagus. The patient was allowed to take some fluid by mouth. A part of it would pass down into the stomach, while some came out through the neck wound. She gradually developed increasing difficulty in swallowing due to contracture of the hypopharynx, and bougienage became necessary.

In the course of time various attempts were made to bring about permanent dilatation of the hypopharynx but they were not successful. There was no disturbance with the function of the larynx but swallowing was impossible.

The patient began to vomit and she developed lymph node enlargement on the right side of the neck. The larynx remained freely movable, and the esophageal fistula closed. Feeding had to be done entirely through the gastrostomy. The fact that she vomited at times showed that she had a passage through the pharynx, and this was demonstrated by passing a bougie. Nevertheless she was unable to swallow, which we attributed partly to scar tissue and partly to the removal of large portions of the constrictor muscles.

The patient died rather unexpectedly July 5, 1925, about five months after operation. Metastases were suspected but not definitely located. Her general weakened condition and myocarditis were held responsible for her death. An autopsy was not permitted.

It probably would have been better to sacrifice the larynx at the original operation. A more complete operation could have been done. All feeding would have been by a gastrostomy tube. If permanent recovery had resulted, a plastic operation for reconstruction of the pharynx could have been done.

CASE 5.—J. D., fifty years of age, admitted July 25, 1925.

Difficulty in swallowing for fourteen months. She had been unable to swallow dry food or meat all that time and was therefore limited to fluids and soft cooked cereals.

The onset had been gradual and she had lost eleven pounds within that time. She had always been frail. Best weight had been 90 pounds. Had always been a light eater. There was nothing of interest in her habits.

An x-ray had been taken a year before and reported negative. It was not repeated. An esophagoscopy had not been done.

The patient was very frail and markedly emaciated. Her present weight was 79 pounds. There was no mass felt and no definitely enlarged lymph nodes. There was slight tenderness in the left side of the neck, to the right of and below the larynx.

A laryngoscopy and biopsy were done and the latter reported squamous cell epithelioma.

July 30, 1925, first operation was performed under colonic ether anesthesia. Complete mobilization of the larynx, hypopharynx, and upper esophagus. Thyroid gland was divided and pushed back laterally. There were no enlarged lymph nodes. A hard, indurated tumor was felt within the upper esophagus and extending into the hypopharynx. The skin flaps were united behind the pharynx. An iodoform gauze tampon was placed at the suprasternal notch to protect the mediastinum. As it was the intention to remove the entire mass, a gastrostomy was decided on and done immediately.

The patient reacted very nicely. Her highest temperature was 101.2° F. She had slight difficulty in breathing until the tampon was removed.

August 10, 1925, second operation. Trachea was divided and sutured to the skin. The esophagus was then divided and the specimen removed. The floor of the mouth was sutured with two rows of fine chromic catgut. The skin flap had healed by primary union. The distal end of the esophagus was closed and the stump dropped back.

The patient's temperature gradually rose to 103.6° F., and she died the third day after operation from general exhaustion.

Pathological diagnosis: Squamous cell epithelioma.

II. CARCINOMA OF THE THORACIC PORTION OF THE ESOPHAGUS

Of the 9 cases in this group 4 were women and 5 were men.

There were 2 patients under forty years of age, only 1 over seventy, and the other 6 were about fifty years old.

In all but 2 of the patients symptoms of difficulty in swallowing had been present for six months or more. In these 2 patients there had been difficulty for only six and eight weeks, respectively. This calls attention to the insidiousness of the condition, which frequently does not give rise to symptoms until obstruction occurs.

The tumor was situated below the arch of the aorta in only 1 patient, in 2 it was so extensive as to involve the entire esophagus from the aorta to the diaphragm, and in the other 6 it was situated behind the arch of the aorta, and extended more or less upward or downward from there.

The operation used in these 9 patients was that developed and first successfully performed by Franz Torek, of New York City, with such slight modifications as seemed indicated in the individual cases.

In only 5 of the patients was it possible to remove the tumor and complete the operation.

In the other 4, usually after ineffectual attempts to mobilize the tumor, the operation had to be discontinued on account of too extensive local disease.

Of the 5 patients in whom the tumor was successfully removed, 3 died within the first three days, and 2 recovered, living seven and one-half and eighteen months respectively. These 2 cases were individually reported in the literature.

The thorax was closed without drainage in 6 patients, while in 3 closed drainage was established. The 2 patients who recovered were drained.

CASE 6.—R. L., seventy-three years of age, admitted October 16, 1917.

Patient had complained of difficulty in swallowing for a year. For three weeks she had taken only fluids. Had lost considerable weight (from 112 to 98 pounds) in a short time.

An esophageal obstruction was found by means of the bougie 30 cm. from the teeth. Verified by x-ray.

October 17, 1917, gastrostomy was performed under general anesthesia. No metastases found.

October 31, 1917, operation: The tumor was situated below and behind the arch of the aorta. It was so adherent that it seemed hopeless to get it out. The opposite pleura and the pericardium were involved. Operation was finally successfully accomplished. The patient's general condition seemed fairly good at the end of the operation.

She died about eighteen hours after operation, apparently from shock.

CASE 7.—J. P., thirty-nine years of age, admitted March 11, 1924.

This patient was reported as a successful case in *Archives of Surgery*, January, 1925,

page 361. A radical operation for carcinoma of the esophagus had been done April 24, 1924.

At the time of publication his general condition was good and there was reason to believe that he would remain free from recurrence. He masticated food in the normal way and swallowed through his rubber esophagus without difficulty.

During the summer of 1925 he began to complain of deep-seated epigastric pain which did not improve under medical treatment. He became progressively worse. His weight diminished until he weighed only 90 pounds. Metastases were considered as the cause of symptoms, but it was impossible to demonstrate them. There was no tenderness over the spine or other bones. X-ray film of the lungs was negative. The mediastinal shadow was normal. There was no lymph node enlargement and the liver was not enlarged. X-rays of the stomach and colon were negative.

A gastric ulcer was considered the most likely cause of the symptoms, perhaps due to division of the vagus nerves or to pressure of the gastrostomy tube. However, it was impossible to demonstrate such a lesion. Gastric acidity was normal and there was no blood present. There was no unusual abdominal tenderness. Ulcer was the working diagnosis nevertheless, but various attempts to bring relief were not successful. It was then decided to put the stomach at rest, atropine was given, and a duodenal tube was inserted through the gastrostomy tube in the hope that it would find its way through the pylorus. This was not the case, however, and the attempt had to be abandoned.

Later the patient began to have hemorrhages, apparently from the stomach, for the blood flowed out of the gastrostomy opening. During one of these severe hemorrhages he died, on October 14, 1925, about eighteen months after removal of his esophagus.

An autopsy was performed and showed a small tuberculous focus in the right apex. There were no metastases above the diaphragm, either in the mediastinum or in the lungs.

The stomach showed a large, ulcerating, carcinomatous lesion at the cardiac end, which had perforated and invaded the pancreas. There was no other metastatic involvement. Microscopic examination of the growth showed squamous cell epithelioma which resembled the primary growth removed from the esophagus.

CASE 8.—J. F., thirty-two years of age, admitted December 13, 1926.

When first seen he had been under medical care with symptoms suggestive of esophageal obstruction for over a year. The condition had been variously diagnosed as cardiospasm and neurasthenia. The first esophagoscopy was done nine months after onset of symptoms and spasm was reported to be the cause of symptoms, associated with inflammation and ulceration. Treatment brought no relief; therefore, esophagoscopy had been repeated. Some improvement, but no positive diagnosis was made.

A third esophagoscopy and biopsy resulted in the diagnosis of adenocarcinoma, and this was confirmed on a fourth examination.

He had lost ten pounds in weight during the year.

His chief complaints on admission were difficulty in swallowing, pain under the right costal arch, and pain in the dorsal spine.

His tumor was reported to be situated in the lower part of the esophagus. The patient's general condition warranted an exploratory operation, and he was eager to be operated upon.

December 13, 1926, gastrostomy; exploratory laparotomy.

A hard, nodular tumor was felt in the subdiaphragmatic portion of the esophagus. It was movable and had not encroached on the stomach. Several small, very hard, lymph nodes were palpable. The liver was not involved. A Witzel gastrostomy was done.

The finding of the tumor at this low level made us decide to attempt a radical trans-

thoracic operation with incision of the diaphragm, bringing the fundus of the stomach up into the chest in order to transplant the esophagus into it.

To facilitate this procedure it was considered advantageous to paralyze the diaphragm. Therefore, on December 23, 1926, an exeresis of the left phrenic nerve was done in the neck under local anesthesia.

December 28, 1926, during an exploratory thoracotomy, an incision was made along the eighth intercostal space. Vertical incision added posteriorly, extending over the ninth, eighth, seventh, and sixth ribs and all these ribs were then divided. Excellent exposure of the lower esophagus was obtained.

It was found that we were dealing with a most extensive carcinoma, reaching from the arch of the aorta to the stomach. It was so nodular and adherent that removal was out of the question. Attempt therefore given up. Chest closed without drainage.

The patient developed pneumonia and died on the third day.

CASE 9.—W. D., fifty-four years of age, admitted December 21, 1927.

Complained of difficulty in swallowing and substernal pain for two months.

X-ray examination showed an obstructive lesion at the level of the ninth dorsal vertebra.

Esophagoscopy showed a tumor 15 inches from the teeth, and a biopsy specimen was diagnosed squamous cell epithelioma.

At operation, January 17, 1928, the tumor was found below and behind the arch of the aorta. It was successfully removed. Metastatic lymph nodes were felt at the cardia and could not be extirpated. Chest closed without drainage.

The temperature rose to 104.6° F. that same evening, was about 105° F. the following day, and the next day went to 107° F. The patient died about fifty-four hours after operation, probably of an acute sepsis.

CASE 10.—B. G., fifty years of age, admitted December 4, 1928.

Difficulty in swallowing food for three months; for one week complete inability to take even fluids. Had lost 30 pounds in weight. Had terrible pain under the sternum and through to the back. Also had a weak heart. Unable to climb stairs.

X-ray examination showed no obstructive lesion and an esophagoscopy revealed an ulcerating tumor mass about 35 cm. from the teeth. Examination of the biopsy specimen was reported squamous cell epithelioma.

At operation, December 20, 1928, the tumor was found behind the arch of the aorta. In separating it from its bed of dense adhesions, it perforated and some foul pus was spilled. Operation completed. Closed drainage of chest established. Patient stood operation very well.

The temperature rose at once and reached 106.4° F. the following evening, when the patient died, about thirty hours after operation, evidently due to sepsis resulting from the perforation of the esophagus.

CASE 11.—A. L., fifty-five years of age, admitted January 23, 1929.

This patient is one reported as a successful case with complete history and operative findings in *Surgery, Gynecology, and Obstetrics*, March, 1930, page 630.

At the time of publication, she had developed metastatic lymph nodes on the left side of the neck, for which x-ray treatments were given.

The patient succumbed to the disease September 24, 1929, about seven and a half months after operation.

The autopsy findings have been reported as follows: There were no metastases present below the diaphragm. The esophageal stump which had been inverted into the stomach was normal. Metastases were found in the mediastinum at the site of operation and extending all the way up into the left side of the neck where there was extensive lymph node involvement and invasion of the thyroid gland. The lungs and heart were not involved. Both pleural cavities were obliterated by adhesions.

CASE 12.—K. W., forty-eight years of age, admitted April 6, 1931.

The patient gave a history of severe knife-like pain under the lower portion of the sternum which had no relation to meals. The first attack had occurred three years previously. She had been more or less symptom-free until six months ago when similar but more severe attacks made their appearance. After a while there was also difficulty in swallowing and this became slowly worse.

She was referred to us from another hospital where a gastrostomy had been done which functioned well. Her present weight was 93 pounds.

An esophagoscopy was done and a biopsy specimen was reported squamous cell epithelioma.

April 9, 1931, operation was performed. A very hard, nodular tumor was found beginning at the lower margin of the arch of the aorta and extending upward behind it. With great care it was possible partly to free the tumor, but apparently there was invasion beyond the line of separation. The tumor was adherent to the descending portion of the arch of the aorta as well as to the main bronchus. To free it, mobilization of the arch of the aorta was necessary. Three left intercostal arteries were ligated, and it was then possible to roll the arch of the aorta over toward the right side. Suddenly there was a severe gush of blood, the origin of which could not be determined at first. With the finger around the aorta, and lifting up on it, the bleeding was controlled. The blood seemed to come from the posterior or right lateral wall. For a moment the hemorrhage seemed alarming. Clamps were of no avail. Blood shot out under great pressure. A silk suture was then placed but it cut through apparently due to softening of the wall of the aorta, possibly from tumor invasion. Three more double silk sutures were then inserted through the thickness of the wall of the aorta and the hole was effectively closed. The lung was at once inflated to overcome the temporary condition of shock.

Attention was then again directed to the esophageal tumor, but it was found impossible to mobilize it. In the depth it seemed to be adherent to the ascending arch of the aorta.

The field remained dry and the chest was therefore closed without drainage.

The patient reacted well and became fully conscious. Fluids were given through the gastrostomy. Bleeding did not recur. She died about forty-eight hours after operation with a temperature of 102° F.

CASE 13.—A. L., fifty-three years of age, admitted August 18, 1931.

The patient had been under care at another hospital where a definite diagnosis of carcinoma had been made and a Janeway gastrostomy performed which functioned perfectly.

Symptoms of obstruction had been present five months. He had lost weight, from 148 to 113 pounds, but since the establishment of the gastrostomy and a well-balanced diet, he had regained 20 pounds.

He had no pain and seemed a fair surgical risk.

August 24, 1931, operation was performed.

The tumor was large; it extended from below up behind the arch of the aorta and somewhat above it. Metastatic lymph nodes were present. The esophagus was liberated in its lower course and light traction was made by means of a tape passed around it. Numerous vessels were ligated and every attempt was made to free the tumor, but it was found to be so firmly attached to the aorta, the hilus of the lung, and to the opposite pleura that it was impossible to mobilize it. Attempt at resection was therefore abandoned. Chest closed without drainage.

The patient reacted well from the operation. He was able to swallow so well that for a while he believed the tumor had actually been removed. He died November 19, 1931.

CASE 14.—W. C., fifty-four years of age, admitted October 9, 1931.

This patient had a history of difficulty in swallowing, extending over a period of seven months. He had lost 50 pounds in five months. He had consulted numerous doctors and had been in several hospitals. A dilatation of the esophagus had been done. Recently he had been in another hospital at which a positive diagnosis of carcinoma was established and a gastrostomy (Janeway) done. It functioned well and since that time he had gained weight. He seemed a fair surgical risk, but x-ray films of the chest looked suspicious of malignant involvement of the lungs.

October 14, 1931, operation was performed. A large tumor was felt in the root of the left lung and several smaller metastatic deposits were noted. The esophageal tumor was an unusually extensive one, reaching from the aorta to the diaphragm. It had involved the surrounding structures to such a degree and was so adherent to the aorta that it was impossible to get a line of cleavage. The chest was closed without drainage.

The patient died on the third day with a temperature of 106° F.

III. CARCINOMA OF THE REGION OF THE CARDIA

Of the 3 patients with a tumor involving the cardia, 1 was a woman.

The ages were forty-five, sixty, and sixty-four years.

In 1 patient symptoms had been present only two months, in the second case four to five months, and in the third, nine months.

In 2 of the patients there was considerable difficulty in reaching a diagnosis. One patient came to us with symptoms suggestive of esophageal obstruction. A bougie could be passed and an x-ray was negative. These same negative findings resulted on a second admission for the same symptoms. It was five months from the time the patient first presented himself before a positive diagnosis was made. An esophagoscopy might have made an early diagnosis possible.

The other patient was placed under medical care as soon as suggestive symptoms appeared. At an early x-ray examination the case was diagnosed as cardiospasm and this diagnosis was persisted in because a subsequent biopsy was reported as not malignant. Not until complete obstruction developed nine months after the onset of symptoms was a correct diagnosis made and proper treatment instituted.

In all cases the operation was done from below and good access was obtained. It seems a good procedure in those cases in whom the tumor does not extend up on the esophagus for any distance. Should that be the case an operation done transthoracically or by the combined method is preferable.

All 3 patients succumbed, 2 due to leakage, and the third apparently due to a cardiac condition with edema of the lungs.

CASE 15.—W. K., forty-five years of age, admitted April 8, 1924.

Was first seen November 10, 1923, complaining of pain in epigastrium for four or five months, associated with some difficulty in swallowing. He had lost 40 or 50 pounds. Gastric analysis showed hyperacidity. X-ray examination was negative. Wassermann negative. He was an alcoholic and his symptoms were attributed to that.

He was seen again February 21, 1924, complaining of the same symptoms. A large

bougie was passed without difficulty and x-ray examination was again negative. Early in April he complained of constant pain and additional loss of weight. He was sent to the hospital for an exploratory operation regardless of x-ray findings. This time, however, a diagnosis of a pathologic condition at the cardia was made, the character of which suggested malignancy. His weight was 123 pounds.

A radical operation was planned, should it be feasible. As a preliminary a gastrostomy was indicated.

April 10, 1924, operation—gastrostomy. Because the carcinoma was supposed to be at the cardia, and that it would later be advisable to mobilize the stomach thoroughly, it was decided to do a right-sided gastrostomy. A right rectus incision was therefore made. No free fluid was found. No metastases in liver. Pylorus and body of stomach not involved. At the cardia a nodular carcinoma was found, apparently completely surrounding the cardia. It had not become adherent to the diaphragm and felt operable. There was no extension to the esophagus above the diaphragm as far as one could determine. No glands palpable. Owing to the extremely poor general condition of the patient radical operation could not be considered at this time. A Witzel gastrostomy was therefore done near the pyloric end of the stomach.

He reacted well and with adequate feedings through the gastrostomy tube he slowly began to regain some of the initial loss in weight.

On May 8, he had epigastric pain with a temperature rise to 102° F., and on the following day to 103° F. This febrile reaction lasted seven days and was not accounted for at the time. (Was later found to have been due to spontaneous perforation of an esophagus carcinoma with mediastinal abscess formation.)

Convalescence was retarded on account of diarrhea and separation of wound margins about the gastrostomy. Radical operation therefore had to be postponed for six weeks, until it was considered safe to proceed.

May 29, 1924, operation was performed. Under local anesthesia an incision was made, beginning well up to the left of the ensiform and then downward along the costal arch, and an inch below it to the tenth interspace and along this space. Muscles were divided down to the peritoneum. Costal cartilages of tenth, ninth, eighth, and seventh ribs were divided close to the junction with the ribs. The entire costal arch was then reflected upward, together with skin, muscles, and peritoneum, and strongly retracted towards the left. The liver was large and interfered with proper access. It was not possible to mobilize it completely, but by holding it well out of the way the cardia was exposed. A very large, hard gland and several smaller ones could be palpated. The access was not as good as had been expected. After considerable difficulty the esophagus was mobilized in the diaphragm and the opening in the latter enlarged to such a degree that it could be used for exploration upward. We then found that we were dealing with a carcinoma of the lower esophagus, instead of a tumor of the cardia, and that the tumor felt below the diaphragm was not the primary tumor but metastatic glands. The esophageal tumor was hard and nodular, and, although situated low, it had not been felt at the time the gastrostomy was done. Without much difficulty it was possible to separate the pleural layers from it, apparently without entering the pleural cavity. However, it was not possible to get beyond the upper limits of the tumor or to pull it downward. To bring it down and implant it into the stomach was therefore not possible. To resect the tumor, close the stomach, and then remove the lower esophagus transpleurally was more than the patient would be able to stand in his weakened condition. It was therefore decided to divide the operation into two stages. The first stage to consist in division of the stomach below the metastatic glands, with closure of both ends, and tamponade of the wound. The second stage to consist of resection of the lower esophagus transpleurally, or if possible, extrapleurally. It was recognized that there was danger in the procedure from gangrene and leakage, because the vessels at

the cardiac end would all have to be ligated, but it was considered the better and safer course nevertheless. Consequently, the vessels were ligated, thus completely liberating the cardiac end of the stomach and the lower esophagus with the lymph nodes. The stomach was divided about four inches below the cardia between clamps and both ends were closed with a double row of sutures. Even then it was impossible to pull down on the esophagus. Tampons were now placed in front and behind the esophagus into the mediastinal space to prevent leakage upward, and additional tampons were placed into the subdiaphragmatic space to surround the stomach stump. Wound then closed in layers, tampons being brought out through the lateral part.

The patient had stood the operation very well, but it was necessary to complete it under general anesthesia.

He was apparently not shocked and reacted very nicely, so that it was decided to do the final stage two days later.

May 31, 1924, second stage of operation for carcinoma of esophagus was performed. It was begun under local anesthesia, and finished under general. Patient was placed on his right side. Resection of part of seventh, eighth, and ninth ribs. Long pieces were removed in order to mobilize chest wall. Intercostal vessels and muscles were ligated and divided. Pleura then stripped away from posterior chest wall towards the mediastinum, in order to gain extrapleural access to the esophagus. In spite of careful manipulation the pleura tore in several places and these tears rapidly increased in size on account of respiratory efforts. However, an attempt was made to continue the plan. Pads were therefore put over the pleura and the esophagus was exposed. This could easily be done. The hole in the diaphragm was enlarged and the gastric stump and metastatic nodes were pulled through. During this manipulation the stomach stump, which had become gangrenous, perforated but its contents were caught in pads. While now attempting to liberate the esophagus in an upward direction, there was a sudden gush of very foul smelling pus, which soiled the field, as well as the pleural cavity. We had entered a large mediastinal abscess due to perforation of the carcinoma. Looking back in the history we found that the patient had sudden epigastric pain with temperature to 103° F. in May, which had not been accounted for. Evidently the perforation had occurred at that time. This spilling of foul pus made the prognosis a hopeless one. The abscess was emptied completely and it was found that the perforation had taken place posteriorly, causing a large abscess. The esophagus was now ligated above the carcinoma and the ligature left long. Esophagus divided and stump cauterized. Tampons inserted into the diaphragmatic opening, as well as into the mediastinum, and the wound then partly closed.

With the holes in the pleura and the spilling of foul pus the outlook was hopeless. Patient returned to bed in poor condition and he expired that evening.

Comments: Important points in case.

1. Inability to make early diagnosis, though he presented himself six months after onset on November 11, 1923.

Had hyperacidity. Stomach tube and bougie passed easily. X-ray negative. Stool negative for blood.

2. On readmission in February, 1924, it was again not possible to make a diagnosis. Stomach tube and bougie again passed. X-ray negative. This time had anacidity.

Continued to lose weight. Should have had an esophagoscopy done.

3. Finally able to make diagnosis by x-rays in April, 1924. However, bougies were still passed for entire length. Did they enter stomach or did they simply push tumor forward into stomach?

Spontaneous perforation took place three weeks before radical operation and formed localized abscess.

4. The operative procedure in this case might have led to a good result had it not been for the presence of an unsuspected mediastinal abscess. The esophagus stump could have been brought out on the chest wall extrapleurally to prevent leakage into the mediastinum.

CASE 16.—C. N., sixty years of age, admitted April 19, 1926.

He had symptoms of esophageal obstruction for two months. X-ray examination was reported suggestive of cardiospasm. After administration of atropine, the symptoms and x-ray findings were unchanged.

An esophagoscopy was then ordered and the lesion found to be 40 cm. from the teeth. A biopsy was reported squamous cell epithelioma of the esophagus with tumor emboli in the blood vessels.

April 24, 1926, gastrostomy under general anesthesia. The lesion was situated at the cardia and seemed to be operable. Exploration revealed no liver or other distant metastases. Attempt therefore to be made to remove it.

May 16, 1926, operation was performed. Resection of lower end of esophagus and upper third of stomach.

An incision was made beginning high up to the left of the ensiform and downward and outward parallel to and a little below the costal arch, as far as the ninth intercostal space. It was carried two inches along this space. The muscles were divided down to the peritoneum. The seventh, eighth, ninth, and tenth ribs were then divided just beyond their junction with the cartilages. The cartilages of these ribs were then divided close to the sternum. It was now possible to evert the flap and gain access to the subdiaphragmatic space, after the peritoneum had been opened. A hard, nodular tumor was palpated in the region of the cardia and along the lesser curvature. Access was difficult. By dividing the ligament extending from the left lobe of the liver the latter could be pushed out of the way. All vessels around the cardia were divided and the cardia and the lower esophagus were sufficiently freed to permit a tape being passed around them. The esophagus was freed upward until it was completely separated about two inches above the tumor. The pleura was not opened. The vessels along the lesser and greater curvature were now ligated, taking care to go well beyond the enlarged, hard lymph nodes on the lesser curvature. The esophagus was then doubly ligated by means of heavy silk ligatures, placed above the tumor, and another extra one placed still higher. By means of an electric cautery it was then divided and the silk ends of the stump were left long.

The upper end of the stomach, with the cardia and lower esophagus, was now pulled out of the wound and the stomach divided between clamps about three inches below the cardia. The open end was closed with two rows of silk sutures and dropped back. A few sutures were then placed to the left of the gastrostomy firmly anchoring the stomach to the abdominal wall and preventing leakage.

The wound looked clean. An iodoform tampon was placed below the esophagus stump and into the lower mediastinum and brought out of the epigastric wound together with the two heavy silk ligatures. A large drainage tube was placed below this and the abdomen was then closed in layers.

The patient was quite shocked and a saline infusion was therefore given.

The first days of the postoperative course were quite satisfactory. On the second day fluids were started through the gastrostomy tube.

On the fifth day there was a small amount of foul smelling discharge around the tampon. It was therefore loosened, as a leak was suspected. He had no pain.

On the eighth day the tampon was removed without difficulty. The margins of the wound looked sloughy, and there was some foul fluid in the wound which was removed

by suction. The esophageal ligatures seemed to be firm. A catheter was inserted to the region of the stump to keep the wound clean by frequent suction. He developed some pain behind the sternum, while the abdomen remained soft. There was a temperature ranging from 101° to 104° F. Mediastinitis was diagnosed. The patient expired on the eleventh day.

An autopsy was not permitted.

The pathologic report was: Carcinoma of the esophagus with metastases in the omental lymph nodes.

Comment: Danger of leakage from the esophageal stump was known to exist. Transplantation of the stump into the stomach might have avoided that, and would have been the ideal method, allowing normal deglutition later. It did not seem feasible at the time. No safe suture could have been done below the diaphragm on account of the short esophagus. It might have been feasible had the entire operation been done from above, drawing the stomach up into the thorax. Another possibility would have been to draw the esophagus out at the neck, but the weakened condition of the patient precluded that at the time.

It was hoped that a double ligature at the lower end of the esophagus would keep it protected sufficiently long to form a peritoneal drainage canal from the lower mediastinum to the skin, and that this canal would act as a safety valve. Unfortunately, an infection apparently developed in the depth as early as the fifth day and spread into the mediastinum rather than to the skin surface along the drains.

CASE 17.—Y. H., sixty-four years of age, admitted March, 1932.

Chief Complaint: Difficulty in swallowing for nine months. Weakness and loss of weight.

She had been under constant medical care. X-ray examinations had been diagnosed as cardiospasm and esophagoscopy and biopsy had been reported as not malignant. Had become progressively worse.

After admission to our hospital she was unable to swallow anything. She was given fluids by proctoclysis. X-ray film showed practically complete stenosis at the cardia. A nodular tumor was palpable under the left costal arch.

The patient was a poor surgical risk. She was anemic and had lost 35 pounds in weight. A gastrostomy was urgently indicated. Her family requested radical operation if at all feasible.

April 4, 1932, operation was performed under general anesthesia. Resection of upper two-thirds of stomach; Esophagogastrostomy.

Median epigastric incision. A large, hard, carcinomatous tumor was found to occupy the entire upper two-thirds of the stomach. It involved the entire circumference. The distal third was normal, and the greater part of the subdiaphragmatic esophagus seemed normal. Involved lymph nodes were palpable at the cardia, but removal of the mass seemed feasible and was decided on.

Incision was carried into the notch to the left of the ensiform. Excellent exposure was obtained. Vessels along the lesser and greater curvatures were ligated, staying well beyond the lymph nodes. Stomach divided between clamps below the tumor. Lower portion closed with two rows of sutures and temporarily packed away in the abdomen. Separation of tumor mass continued, which was difficult in the region of the spleen and from the pancreas. The stomach was finally completely mobilized so that it remained attached only to the esophagus. By gentle traction on this and blunt

dissection, about 2½ to 3 inches of normal esophagus were obtained which permitted turning the stomach over and laying it on the chest wall, thus putting the esophagus on the stretch. The tumor involved the cardia and had encroached on the esophagus.

The lower stump of the stomach was now drawn up behind the esophagus as far as possible and fastened there with three silk sutures. This placed the anterior wall of the stomach in contact with the posterior wall of the esophagus. A few sutures were placed on each side of the esophagus attaching it to the anterior wall of the stomach down to the place where division was contemplated. A few additional transverse sutures were placed here, the esophagus was then divided, and the entire tumor mass removed. A transverse incision was now made in the stomach opposite the divided esophagus and the two posterior margins were united with interrupted chromic catgut.

A stomach tube was then passed up the esophagus in a reverse direction and a duodenal tube attached to its lower end and drawn upward out of the mouth. The lower end of the duodenal tube was pushed into the open stomach stump and then through the pylorus well down into the duodenum, to be used for feedings immediately after operation. The anastomosis was now closed anteriorly with interrupted chromic catgut, and the anterior wall of the stomach then drawn upward on the esophagus well beyond the deep suture line, and fastened with interrupted silk. This produced an invagination of the esophagus into the stomach. A few lateral sutures were now placed approximating the lateral surfaces of the stomach to make the anastomosis more secure. There seemed to be no tension.

The patient stood the operation well. There had been slight spilling of stomach contents but on the whole the field was clean and the abdomen was therefore closed in layers without drainage.

A hypodermoclysis was given during the early part of the operation and towards the end a transfusion of 500 c.c. of blood.

The patient reacted well from the operation. Fluids were given through the tube on the first day and gradually increased. They were well borne. Everything was going well until the end of the fourth day when there was a temperature rise of 104° F. with corresponding increase in pulse and respiratory rate. No definite cause for this was found, but her condition was not so good after that. There were no gastric or intestinal symptoms. She took all her food well, without any distress. The bowels moved spontaneously and the abdomen was soft and normal.

Diffuse râles were heard in the chest and, with a weakened heart, edema of the lungs developed to which the patient succumbed six and one-half days after operation.

An autopsy was not permitted.

The pathologic examination of the specimen showed adenocarcinoma of the stomach and esophagus, with metastases in the omental, esophageal, and mesenteric lymph nodes.

SUMMARY

A series of 17 cases of carcinoma of the esophagus is presented: 5 affected the upper end, 9 the thoracic portion, and 3 the cardia.

Not one of these patients was an early case. In the majority symptoms had existed for over six months before a correct diagnosis was made.

In several patients in whom the diagnosis of cancer was suspected, too much importance was attached to a negative x-ray examination. In all patients in whom symptoms persist, reexamination is urgently indicated.

Esophagoscopy with biopsy is the surest way to make a diagnosis. Unfortunately, this method is not resorted to as often as it is indicated. It is urged that patients with suspicious symptoms be sent for examination

early. Several cases in this series had a biopsy done with a report, "no malignancy," when in reality a cancer was present. One must therefore not accept one negative report as final if the symptoms are suggestive.

Unfortunately, there are no real early symptoms, meaning by that symptoms which would make one suspect the disease in its early stages. It is usually not until there are symptoms of difficulty in swallowing that the patient complains, and that generally means some degree of obstruction and advanced disease. All patients complaining of difficulty in swallowing should be examined with all the means at our disposal, especially x-ray and esophagoscopy.

Not until patients are referred for surgical treatment before they have become emaciated, dehydrated, and discouraged, and with the local disease less far-advanced than in the group here reported, will it be possible to achieve substantially better results.

It is recognized that even with an early diagnosis, and a patient in fair condition, an operation for carcinoma of the esophagus will always be a formidable one. However, the technical difficulties have been largely mastered, so that the problem looks less difficult than some years ago.

In only 13 of the 17 cases here reported was it possible to remove the tumor and complete the operation. Of this group 4 patients got well and lived for months, a recovery of almost 32 per cent.

Taking the groups individually, there were 2 recoveries among 5 upper esophagus cases, a mortality of 60 per cent. There were also 2 recoveries among the 5 patients in whom a carcinoma of the thoracic portion was resected, likewise a mortality of 60 per cent.

If that much can be accomplished in the group of advanced cases presented in this report, with anemia, metastases, and dehydration, how much more may we expect if cases are referred before they have reached this deplorable state.

I want to acknowledge my gratitude and appreciation to the men on the staff of the Lenox Hill Hospital who helped in the diagnosis of these cases.

Drs. J. D. Kernan, and G. F. Oberrender, in esophagoscopy.

Drs. G. L. Rohdenburg, and F. D. Bullock, in pathology.

Drs. Wm. H. Stewart, and H. E. Illick, in radiography.

DISCUSSION

DR. JOHN ALEXANDER (ANN ARBOR, MICH.).—Published reports of esophageal resection for carcinoma are few enough to call for others which, even though unsuccessful, should help to point the way toward success. The patient I am reporting was an old woman with a carcinoma involving the upper esophageal orifice, the right pyriform fossa, the right arytenoid, and the hypopharynx. I removed the entire larynx, the hypopharynx, the upper 3 cm. of the esophagus and the entire right lobe of the thyroid because it was adherent to the region of the principal cancerous involvement. It was possible, after undermining, to reunite by suture the posterior walls of the pharynx and the esophagus and to form a satisfactory new anterior pharyngeal wall with the anterior cervical muscles. In order to protect the sutured structures the patient was

fed through a tube for about two weeks and her head was kept slightly flexed for a time.

The patient made a good immediate recovery and died a month after operation from bilateral pneumonia which presumably developed from aspiration of wound secretions into the trachea which had failed to unite with the skin by primary union, probably because a two-stage operation had been used. At necropsy no local or metastatic carcinoma could be found. The reconstructed pharynx and esophageal orifice were completely lined by epithelium and there was no apparent tendency to stricture.

EIGHT YEARS OF SELECTIVE COLLAPSE FOR PULMONARY TUBERCULOSIS*

FRANK S. JOHNS, M.D., AND DEAN B. COLE, M.D.
RICHMOND, VIRGINIA

CERTAIN observations stand out from our experience in the treatment of pulmonary disease. We wish to call attention primarily to our results in a series of cases treated with a selective collapse, and to the behavior of these cases over a number of years. Several years ago we brought before this association a small series of cases treated by this method. At that time, we were still uncertain as to their outcome. Since then, we have become bolder and more confident.

In discussing selective collapse, we mean the term to include partial and compressive collapse, whether unilateral or bilateral, and "optimum collapse" which is the goal of all collapse therapy. We believe that the selection of patients is the controlling factor in expectant results. We are convinced that collapse therapy should be considered as an entity, and that each patient must be considered individually.

Patients selected for collapse therapy, for convenience, may be divided into two groups. In the first, we have those who need immediate collapse. These include emergencies, such as severe unilateral hemorrhage, unilateral exudative tuberculosis, and tuberculous pneumonia; patients who have received expectant treatment with maximum benefit, among them, many patients who have had long periods of sanitorium treatment with improvement, but who have recently had a unilateral spread and become anxious for surgical relief. In the second group of patients for whom selective collapse is indicated no seeming emergency exists. Here we have patients who fail to respond to expectant treatment; unilaterally progressive cases; nearly all early and all latent patients with cavitation. If the cavitation is bilateral many of these will improve sufficiently in one lung to justify surgical closure of the cavity in the other lung.

For nearly all hopelessly advanced cases, radical surgery is seldom justified, either as a temporary or palliative measure; among these are patients with severe complications which will not be helped by improvement of tuberculosis, such as severe cardiorenal disease, diabetes, and uncontrolled tuberculous enteritis.

In all cases our choice of procedure must depend upon the extent, duration, and type of disease present; on previous treatment and the patient's resistance; on the balance between his symptoms and pathologic condition; the presence or absence of adhesions; and upon his social and economic circumstances.

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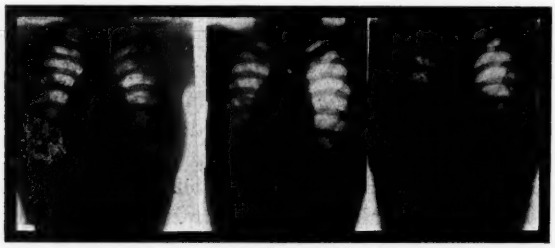
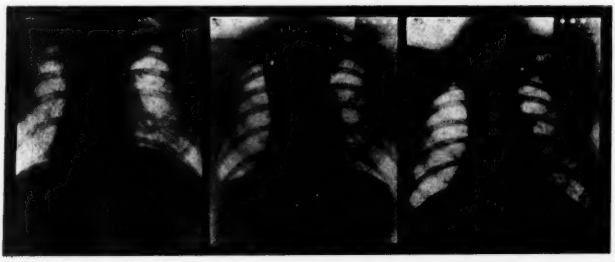
*Read at the Fifteenth Annual Meeting of the American Association for Thoracic Surgery at Ann Arbor, Michigan, April 18, 19, 20, 1932.

The following types of patients should be considered for *pneumothorax*: patients who have not improved under expectant treatment, tuberculous pneumonia patients, and patients developing fluid; also, every patient with unilateral disease whose economic status demands speedy recovery, and patients with minimal lesions, whose sputum is repeatedly and consistently positive. Compressive pneumothorax may be used to stretch adhesions or to produce a more satisfactory collapse. Shifting of the mediastinum occurs frequently, especially in young patients. This is overcome



A. B. C.

Fig. 1.—Pneumothorax with production of fluid to produce adhesions with fixation of the mediastinum. A. Large cavities in right upper lobe. B. Pneumothorax right lung. Shifting of mediastinum shows fluid produced for fixation of mediastinum. C. Fixation mediastinum; base of lung is being permitted to reexpand partially.



A. B. C.

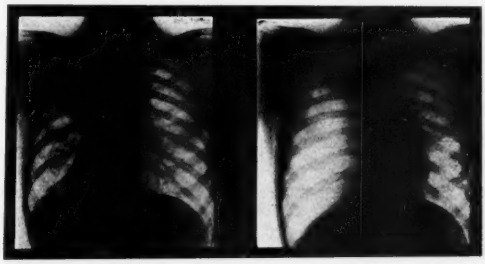
Fig. 2.—A. Patient had had an advanced bilateral tuberculosis. First diagnosed six years ago. After two years' treatment the right lung improved sufficiently to permit collapse of the left lung by pneumothorax. B. Lung collapsed with pneumothorax high, positive pressure being used; this was made possible by the production of fluid with fixation of mediastinum. Apical cavity still uncollapsed. C. Collapse of apical cavity by apical thoracoplasty supplementing pneumothorax.

by the production of fluid. A small quantity of hypertonic saline, or 1 per cent gentian violet is a satisfactory irritant to produce sufficient fluid for the formation of adhesions and the stabilization of the mediastinum. If necessary stronger irritant may be used without harm. In selective pneumothorax it is important to avoid a movable mediastinum and mediastinal hernia.

Development of fluid is no contraindication to the continuance of pneumothorax; tuberculous empyema is another condition which can often be

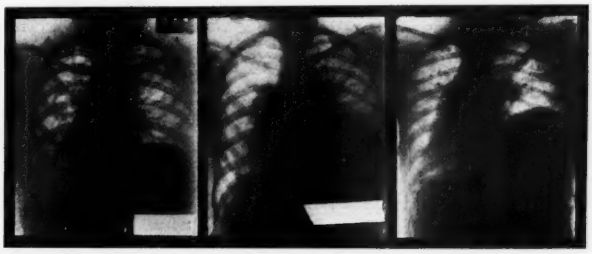
successfully treated with pneumothorax, plus aspiration and irrigation with normal saline, and when necessary with instillation of 1 to 2 per cent gentian violet, or 20 to 40 c.c. of lipoiodine. Gentian violet will control the staphylococcic infection and the iodized oil is a deterrant to all mixed infection.

Surgery of the phrenic nerve is indicated where either temporary or permanent paralysis of the diaphragm is desired; for recent thin-walled superficial cavities; for moth-eaten soft-walled cavities; as an aid to pneu-



A. B.

Fig. 3.—A. Advanced tuberculosis of the left lung. B. Collapse of lung with pneumothorax. Marked positive pressure. Apex of lung still uncollapsed. This is an ideal case for an apical thoracoplasty supplementing pneumothorax.



A. B. C.

Fig. 4.—This patient had had a bilateral tuberculosis with an advanced lesion on the right side. After two years' bed rest, right side phrenicotomy was done. A. X-rayed three months after phrenicotomy, showing large hilus cavity on left. B. Shows pneumothorax on left with partial collapse of cavity. C. Shows obliteration of cavity at time of discontinuance of pneumothorax—two years later.

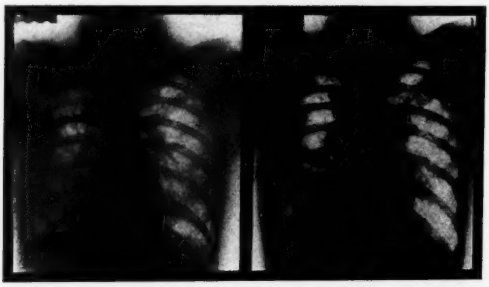
mothorax where the base of the lung remains uncollapsed, and with or without diaphragmatic adhesions. This paralysis may be unilteral or bilateral. It may be indicated where pneumothorax is impossible, or impractical. It may also be used as an insurance measure for patients returning to work after sanitorium or other treatment, with a lesion undergoing resolution; patients for whom pneumothorax has been for some reason discontinued.

Phrenicotomy or phrenic avulsion is seldom indicated in patients with adhesions immobilizing the diaphragm, or in patients with acute progressive disease.

For the closure of cavities in the treatment of the more advanced tuberculous patient, we have found *selective thoracoplasty* to be our most effective measure. For patients with unilateral cavities and little other lung damage, a partial thoracoplasty is our choice. It is also indicated in chronic, essentially unilateral lesions of the fibrous type, and for symptomatic relief of patients with atelectasis due to fibrosis and adhesions. Many of these have marked mediastinal displacement with both cardiac and respiratory symptoms. Symptomatic relief produced by partial thoracoplasty in these patients, especially patients with pericardial adhesions, is most spectacular.

Bilateral apical thoracoplasty is indicated when there are cavities in both apices, with the remainder of the lungs good.

Complete thoracoplasty is indicated in cases of pyopneumothorax and tuberculous empyema which have not responded to more conservative



A. B.

Fig. 5.—Patient had had long period of sanitorium treatment with pneumothorax on right side. A. Shows soft-walled cavity in left upper lobe with thickened pleura on the right. At this time phrenicotomy was done on the left. B. Six months after phrenicotomy there was complete disappearance of the cavity.

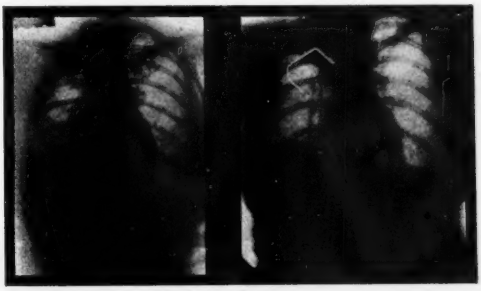
measures; and in certain pneumothorax patients where the lung will not reexpand.

In our early experience with thoracic surgery, we accepted the standard thoracoplasty without question, when indicated as previously mentioned, following the principles of Sauerbruch and others in all of our operative cases. The greater number of our cases have had the complete, or standard, operation. But it is with our more recent and the minority group of patients, who have had a less extensive selective surgical collapse during the past eight years that our present observations are chiefly concerned.

Our results with the standard thoracoplasty were reasonably good. But we soon realized that this extensive resection of ribs, even in stages, had the disadvantages of any serious surgical operation. It carried a mortality of some note, and kept the patient in the surgical hospital from three to six weeks, depending on his general condition and upon how well the operation was borne. Influenced by these results, we began to consider the advan-

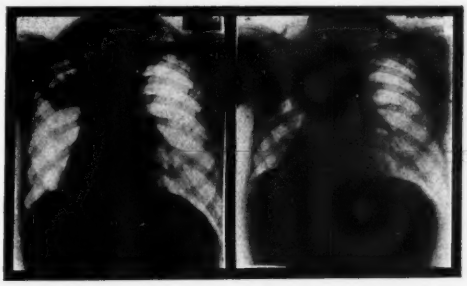
tages of resecting a limited number of ribs immediately about the cavity, instead of proceeding routinely with the classic thoracoplasty. It has been our good fortune to follow every one of our series of cases on which we have used this selective collapse therapy.

Our first patients chosen for this type of surgery included one who had already benefited from pneumothorax, although an apical cavity remained unclosed. With the hope of improving her general condition, we resected



A. B.

Fig. 6.—This patient had had long period of sanitorium treatment but continued to be an invalid. A. Apical consolidation and cavitation on the right. Apical thoracoplasty was done at this time. B. For three and one-half years since apical thoracoplasty the patient has remained entirely well.



A. B.

Fig. 7.—This patient had had long period of sanitorium treatment. A. Large cavity in left upper lobe at which time apical thoracoplasty was done for closure of cavity. B. Three and one-half years after operation patient continues entirely well. Has worked for past three years.

the upper five ribs, anticipating the removal of sections of the lower ribs at a later date. The immediate results were most encouraging to the patient, who was averse, in her improved condition, to further surgery. The experience recorded by other surgeons caused us some concern for this patient's future. A careful follow-up of several months, however, proved our fears unfounded; nor was there any extension away from the apex of the localized lesion. Two more patients selected for partial collapse in our early work had conditions obviously unsuitable for complete thoracoplasty.

One had a unilateral apical cavitation without other involvement; the other had an apical cavity with extensive bilateral involvement.

The gradual definite improvement noted in each of these differing cases, after a less severe and less shocking operation, made its impression on both internist and surgeon. We proceeded to seek further information to determine whether such favorable progress was more than temporary, and if, in a limited number of cases suitable for selective surgery, we were to expect permanent results.

Our findings have been conclusively affirmative.

Realizing that a resection of sections of the ribs of the entire chest wall, is a major procedure, we were further influenced to consider the less severe operation in every case for which we believed it might turn the tide. We are now convinced that it is extremely desirable, in tuberculous surgery, to attack the disease at the strategic point of its gravest involvement. For the patient with apical cavities, there is no indication for phrenicotomy and

A. B. C.

Fig. 8.—A. Advanced bilateral tuberculosis with large cavity in right apex. B. Two years after operation showing cavity closed, lesions completely healed. C. Six years following operation showing lungs completely healed, patient having been entirely well for past five and one-half years.

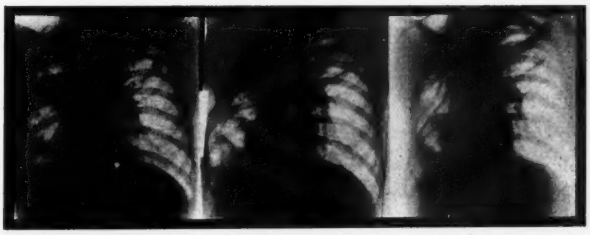
resection of the lower chest wall. For the patient with basal involvement we do not advocate an apical collapse. We may here reiterate the axiom that one should always adapt one's operation to the pathologic condition present. That is, the basic principle which justifies this limited collapse operation in a chosen number of surgical tuberculous patients.

One cannot always prognosticate the amount of collapse which will follow any operation. This is well illustrated by the results of phrenicotomy. We had formerly no idea of the amount of collapse which can be produced by operation on the phrenic nerve. Patients with soft-walled cavities or small apical cavities have been completely collapsed following phrenicotomy. Our striking results have led us to agree with those who now advocate that this less serious operation be given the opportunity to get its maximum results in certain cases, before considering a thoracoplasty. We are convinced that with our selected cases a longer time should be allowed to elapse following the phrenic operation, before resorting to further surgery, and, by so doing, that fewer thoracoplasties will be necessary.

In this series of cases our operative plan has been to resect the thoracic

cage over the lesion, removing only enough of each resected rib to result in the obliteration of the cavity. This operation can usually be carried out in one stage. Occasionally, however, one must resort to further surgery, especially if the cavity is closely associated with the anterior chest wall. In such an event, it will be necessary to augment the operation later by removing anterior sections of the ribs. We have concluded that removing a sufficient amount of each of the ribs over the cavity is very important. In other words, the *amount* of each rib removed is of equal importance with the *number* resected.

We have made no effort to follow any established precedent; but have selected the type and extent of operation for the individual case, our hope and plan being always to get the required collapse exactly where it was indicated. In every case we have followed closely the progress of the tuberculous development: whether this operation had resulted in an extension



A. B. C.

Fig. 9.—This patient had three years of expectant treatment. A. Bilateral tuberculosis advanced; lesion of the left with tenting of diaphragm due to adhesions. B. Following phrenicotomy and apical thoracoplasty. Although phrenicotomy produced marked elevation of diaphragm, patient has not benefited from this operation and an apical thoracoplasty was insufficient to close all honey-combed cavities. C. Following resection of a portion of all ribs. A complete collapse was deemed inadvisable due to conditions of contralateral lung. Patient is practically sputum-free and entirely free from tubercle bacilli.

to other parts of the lung immediately after operation, or at a later date; would the sputum, once freed of the tubercle bacillus, result in a recurrent positive sputum. Our late results demonstrate definitely that our selected collapse cases get better results than many of those who have had the complete thoracoplasty. The majority of patients with entirely localized cavities should have such cavities closed, but the function of the good part of the lung must not be impaired.

We do not want to be misunderstood on this subject. We would not have it assumed, from our argument for partial thoracoplasty, that we mean to exclude the usefulness of the complete thoracoplasty. But it is our conviction, based upon our experience, that for a large number of cases with localized lesions, partial selective thoracoplasty is the operation of choice. Our declared principle in this field of surgery is to fit the type of operation to the patient (whatever may be the individual type of lesion) rather than to follow any stereotyped or mathematical procedure.

THE SURGICAL TREATMENT OF CARCINOMA OF THE LUNG*

EDWARD D. CHURCHILL, M.D.
BOSTON, MASS.

A NUMBER of recent monographs and essays[1, 2, 3] have collected and reviewed the available data relating to the natural history of primary carcinoma of the lung. Incidence, histogenesis, diagnosis, classification, and roentgenology are aspects of the subject that are dealt with at length. Treatment, however, the end and aim of clinical medicine, is either not mentioned at all, or dismissed as was the March Hare's wine—"There isn't any."

In an evaluation of our knowledge concerning pulmonary cancer it must be kept in mind that the existing information is based almost entirely upon autopsy findings in terminal cases. It is only within a very few years that the diagnosis has been made with any degree of surety during life, and even at the present time, with rare exceptions, the far-advanced cases are the ones that come under our observation. It is no wonder, therefore, that these tumors are described as having a "vigorous metastatic power" (Fried) and that "to make a diagnosis of primary carcinoma of the lung or bronchus is tantamount to signing the patient's death warrant" (Davidson).

As a matter of fact, there is very little evidence to indicate a priori that carcinoma of the lung is inherently more malignant than carcinoma elsewhere. On the contrary, the prolonged course of certain cases seems to show that the tumor may be relatively slow to extend or metastasize. Two circumstances governing the metastasis of pulmonary carcinoma are unique attributes of this tumor; first, the apparent ease by which the growth may be disseminated throughout one or both lungs by bronchial embolism, and second, the possibility that cells proliferating within radicles of the pulmonary veins may be carried through the heart into the arterial system without taking the course through the capillaries of the lung required of other tumors.

If thoracic surgeons hope to make progress in the treatment of this disease, the road that must be taken is the difficult one that our predecessors have laboriously followed in developing the treatment of malignant disease of other organs. The problem of earlier diagnosis will always be with us; for years information must be gleaned from discouraging attacks on advanced and inoperable cases. Distant metastasis will, except in rare instances, earmark the cases in which palliative measures alone are to be considered. Information in regard to regional metastases is badly needed, for this subject has proved the cornerstone of successful treatment of malig-

*Read at the Fifteenth Annual Meeting of the American Association for Thoracic Surgery, Ann Arbor, Michigan, April 18, 1932.

nant disease in other locations. To this end careful anatomic and pathologic studies of the tracheobronchial lymphatic system must be secured and correlated with clinical observations. The paths of local extension to the pleura, mediastinum, and adjacent lobes of the lung must be observed and recorded in as great detail as the analogous habits of tumors of the abdominal viscera have been observed. Even were all these data available, unsolved technical difficulties would still bar the approach to what is one of the most inaccessible regions of the body. It requires a courageous degree of optimism to suggest that the time will come when a complete resection of an early carcinoma of the lung with a careful dissection of the regional lymphatic nodes can be carried out with fair prospect of success.

Prophecy and speculation are out of place, however, in an approach to such a grim and difficult subject. It is my wish humbly to record the results of a very limited experience with the operative treatment of pulmonary carcinoma. Cases in which carcinoma was an unexpected finding at operation, as in a certain number of lung abscesses, and cases in which thoracotomy was performed as a last resort in order definitely to exclude an undiagnosed empyema or a benign tumor, will not be considered. In the following cases operation was deliberately planned and carried out in patients known to be suffering from pulmonary carcinoma.

The first two cases will be summarized briefly, as the tumors were found to be inoperable when exposed.

CASE 1.—A male patient, aged fifty-two years, complained of severe and constant pain in the left shoulder and upper arm of six months' duration. He had also experienced pain in the left midchest, but no symptoms referable to the right chest where his tumor was located. Physical examination revealed an effusion in the right pleural cavity confirmed by x-ray studies. Fluid to the amount of 3800 c.c. was withdrawn from the chest and largely replaced by air. The fluid was grossly bloody and showed a specific gravity of 1.025 with 6.53 per cent protein. The x-ray films after the withdrawal of the fluid showed an irregular area of density at the right lung root interpreted as malignant disease. A lateral view showed the lung drawn forward in the pneumothorax to the anterior chest wall at the level of the fifth rib. Bronchoscopic examination by Campbell Smythe showed the trachea encroached upon from the right side above the carina, but no outcropping or evidence of tumor. X-ray following lipiodol injection demonstrated obstruction of the bronchus entering the dense area of the lung field.

Under avertin anesthesia with intratracheal administration of oxygen and nitrous-oxide the pleural cavity was explored by resecting the fifth rib in the midaxillary line. The upper lobe of the lung was found drawn anteriorly and fixed to the chest wall at the level of the fourth costal cartilage. At this point there was a plaque of firm tumor tissue extending from the lung through the pleura into the intercostal muscles. Numerous small nodules were widely distributed on the surface of the pleura, particularly on the mediastinal aspect above the lung root. A specimen taken for microscopic examination showed adenocarcinoma.

The incision was closed without drainage and the patient's convalescence was uneventful. Deep x-ray therapy was advised as a palliative measure.

CASE 2.—A second male patient aged fifty-two years entered a neighboring hospital complaining of a chronic slightly productive cough of two months' duration. A week before entry he had been taken acutely ill with a sharp pain in the right chest and a high

fever. He started to raise a moderate amount of thick blood-tinged sputum. There were signs of fluid at the right base but none was obtained by thoracentesis. A mild diabetes was easily controlled by diet and insulin. The clinical course was that of abscess of the right lower lobe and this diagnosis was supported by bronchoscopy and repeated x-ray examinations.

After six weeks of observation and treatment by postural drainage, a segment of the seventh rib was resected and a large abscess cavity drained. The temperature fell to normal and the sputum decreased from 200 c.c. to 15 c.c. in twenty-four hours. Two and one-half months after the first operation a plastic operation was performed to fill in the cavity. At this time some deep tissue was removed in order to further the plastic procedure and the pathologist reported a finding of bronchiogenic carcinoma.

The patient was transferred to the Massachusetts General Hospital five months after the date of his entry to the other institution. On the posterior aspect of the right chest was a deep cavity discharging thin foul pus. Pulmonary osteoarthropathy was marked.

X-ray films showed a spherical area of density in the lower and posterior part of the right lung field. Within the dull area was a cavity with a fluid level. Bronchoscopic examination by Dr. Smythe gave no evidence of tumor or of widening of the carina.

Operation was performed under avertin and intratracheal nitrous-oxide oxygen. The fifth rib was resected just above the sinus in the chest wall and the pleural cavity was explored by spreading the incision. The upper portion of the pleural cavity was free from adhesions. Within the mediastinum just below the arch of the azygos vein were several large hard lymph nodes. The presence of these nodes in my judgment made the case inoperable. Healing occurred without infection despite the fact that the incision was made with the electrocautery in close proximity to the infected sinus, and despite the anemia and diabetes of the subject.

The tragedy in these two cases as is so common in malignant disease, lies in the failure to establish a diagnosis at a time when surgical measures can be effectively applied.

In the third case a lobectomy was performed and the patient died of pneumonia on the third postoperative day.

CASE 3.—A forty-two-year-old man was referred to the hospital with a complaint of paroxysms of coughing for nine months. He raised very little sputum but had coughed up some blood clots on two occasions four months previously. For a number of weeks his doctor had treated him for rheumatism because of pains in his ankles and knees. All of his teeth had been extracted in an effort to eradicate foci of infection. Of course, his rheumatism was acute pulmonary osteoarthropathy, which he had to a marked degree. Physical examination showed diminished breath sounds throughout the lower half of the right chest posteriorly, with normal tactile fremitus and percussion note, signs interpreted as partial bronchial occlusion.

Bronchoscopy at the Lahey Clinic by Dr. Hoover had established a diagnosis of squamous cell carcinoma in the bronchus of the right lower lobe. The upper margin of the growth was approximately fifteen millimeters beyond the opening of the middle lobe bronchus. X-ray films in the lateral position showed a wedge-shaped area of atelectasis extending downward and backward to the periphery. At the apex of this triangle was the rounded area of density formed by the tumor.

Artificial pneumothorax was instituted and the right phrenic nerve was crushed as preliminary measures. Thoracotomy was performed under nitrous-oxide oxygen anesthesia with a tightly fitting face mask and a water-sealed expiration valve. The right lower lobe was adherent to adjacent structures on all of its surfaces. The tumor was palpable as a round, firm mass close to the lung root. After freeing the adhesions and dividing the pulmonary ligament, the artery and vein were separately ligated and the bronchus was cut across. Because of the reported impossibility of securing pri-

mary closure of a large bronchus, it was planned in this case to accept a bronchial fistula that could be dealt with later. A soft rubber tube was therefore sutured to the stump of the bronchus and led outside the chest. A catheter was placed in the dependent portion of the pleural cavity. The patient left the table in good condition and was kept under the influence of opiates. A slow stream of oxygen was administered through the tube leading into the bronchus.

For twenty-four hours the condition of the patient was excellent then the temperature became elevated and numerous râles were heard throughout the chest. Aspiration of the tube in the bronchus yielded mucopurulent secretions loaded with encapsulated pneumococci. The catheter in the pleural cavity registered eight to ten centimeters of negative pressure in the partial pneumothorax. On the third day the patient died with a clinical diagnosis of bilateral bronchopneumonia. Autopsy confirmed this diagnosis. The tracheobronchial lymph nodes were carefully searched without finding evidence of metastases. There were no distant metastases recognized in a complete autopsy that included the brain.

Examination of the lobe removed at operation showed a circumscribed and well-differentiated squamous cell carcinoma. If this tumor had occurred in the tongue or lip it would have been graded either as I or II.

The unsuccessful outcome in this case is attributable to faulty surgical methods rather than to delay in diagnosis. The patient was in good physical condition and the carcinoma of low-grade malignancy and entirely localized. The approximation of the rubber tube to the stump of the bronchus is thought to have been a predisposing factor in the causation of the fatal pneumonia.

In the fourth case the lower and middle lobes of the right lung were successfully resected for adenocarcinoma of the bronchus. This case is presented not as a cure of cancer of the lung but because of its technical interest. The nature of the tumor, however, gives reason to hope that it has been completely eradicated.

Case 4.—D. M., aged twenty-nine years, coughed up two mouthfuls of bright red blood during her first pregnancy five years before she came under our observation. This hemorrhage came out of a clear sky without previous symptoms. Two years before her entrance to the hospital she developed scarlet fever followed by pneumonia, for which she was confined to bed for four weeks. Each succeeding winter she had an attack of bronchitis with what was termed "dry pleurisy" on the right. Sixteen months before admission she again coughed up blood, and this time to the amount of two ounces. Another more massive hemorrhage followed within a month, followed by pain in her left chest. She was sent to a tuberculosis sanitarium where she remained for six months, having one hemorrhage amounting to six ounces during this period. Two further hemorrhages after she returned to her home led her to enter the State Sanitarium at Rutland. At that institution bronchoscopy was performed and a diagnosis of adenocarcinoma of the bronchus established by removal of a fragment of tissue. A rounded mass was observed apparently obstructing the entrance to the lower lobe bronchus and extending to within a few millimeters of the opening of the bronchus to the middle lobe. X-ray examination confirmed the presence of a spherical mass in this region that appeared sharply circumscribed, particularly after it was thrown into relief by an artificial pneumothorax. Lipiodol entered certain portions of the lower lobe, showing a lack of complete bronchial occlusion.

The right phrenic nerve was crushed and the patient given a course of vaccine prepared from virulent strains of pneumococci including one strain cultivated from her own nasopharynx. Special attention was given to the hygiene of the oral cavity.

On August 10, 1931, the lower and middle lobes of the right lung were removed

after isolation and separate ligation of the branches of the pulmonary vessels supplying them. The operation was performed under avertin anesthesia with oxygen administered intratracheally to supply differential pressure. The stump of the bronchus was fixed by two sharp hooks and a continuous suture of chromicized catgut used to close

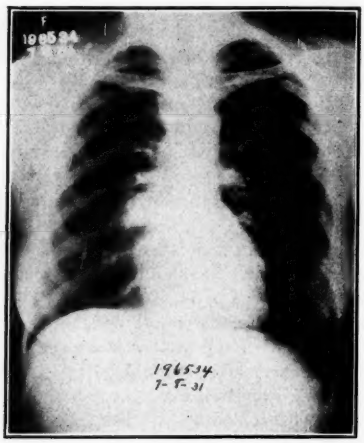


Fig. 1.—Roentgenogram showing the tumor in region of hilum of right lung.

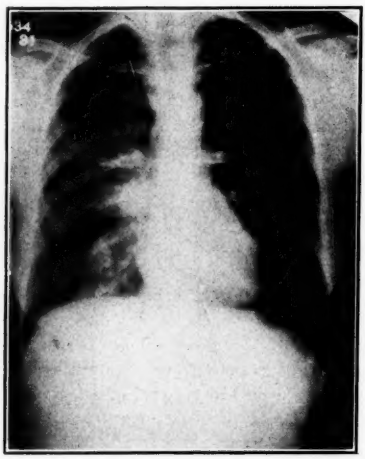


Fig. 2.—The tumor is thrown into relief by the preoperative artificial pneumothorax.

the aperture. The peribronchial and mediastinal tissue was drawn over the line of suture by interrupted mattress sutures. In separating the middle lobe from the upper lobe in the area of anatomic fusion, the electrocautery was employed. The denuded surface of the upper lobe thus produced was drawn over the bronchial stump and sutured to the mediastinum. A catheter was inserted between the ribs just above the diaphragm.

There was little or no postoperative shock and the convalescence of the patient was relatively uneventful. As the catheter ceased to function after the sixth day, it was removed, as by that time the upper lobe was well expanded.

The patient was discharged from the hospital with the wound healed by first intention. Four months later she returned with a small empyema pointing in the midaxillary line due to infection of a residual pocket of serum by B. proteus. The cavity was of approximately one ounce capacity and did not communicate with the bronchial tree.

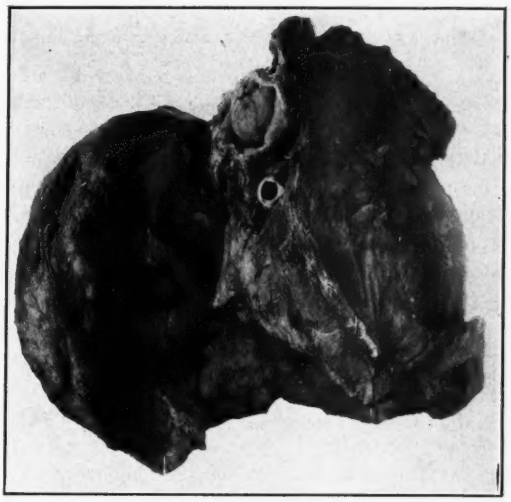


Fig. 3.—Photograph of specimen showing tumor presenting at carina between right lower and middle lobes. The pulmonary vein is shown at the upper end of the pulmonary ligament.

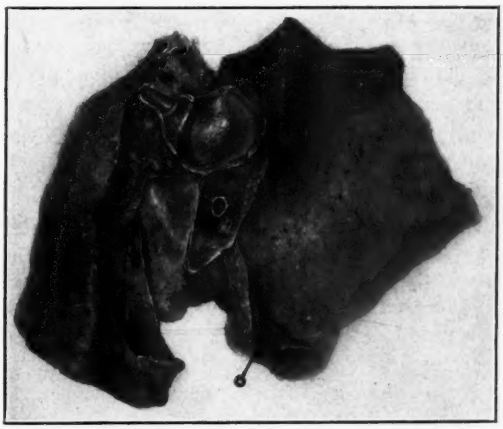


Fig. 4.—Artist's drawing of specimen.

Microscopic examination of the tumor showed it to be composed of rather small masses of epithelial cells in a definite alveolar arrangement with occasional rather im-

perfect gland formation. Scattered through the tumor were a few well-differentiated gland- and duct-like structures which were interpreted not as parts of the tumor but as persistent remnants of the bronchial mucous glands. The tumor was not encapsulated and showed definite invasion at the periphery, but it was on the whole well circumscribed and did not reach to the edge of the section at any point. It was evidently slowly growing since mitotic figures were extremely infrequent. A lymph node only two millimeters distant showed no evidence of metastasis. The diagnosis of the pathologist was adenocarcinoma of the bronchus.

On the basis of clinical observations and a study of autopsy material the following suggestions are offered regarding the diagnosis of carcinoma of the lung and its surgical treatment. Many of the procedures suggested, particularly those concerned with technical matters must be held open for constant revision and modification. In fact the only excuse for their formulation is to provide a working basis for discussion and further extension of our knowledge.

Diagnosis.—Patients with hemorrhage from the lung as the presenting symptom must be subjected to bronchoscopy and lipiodol injection unless typical x-ray findings or a positive sputum confirm the diagnosis of tuberculosis. Pulmonary cancer, as well as the "dry hemorrhagic" type of bronchiectasis, is frequently labelled tuberculosis because of a lack of effort to establish a correct diagnosis.

The signs and symptoms of bronchial obstruction are as important to the thoracic surgeon as those of intestinal obstruction to one doing abdominal surgery. Collateral respiration described by van Allen as existing within a lobe has not been observed with the prolonged bronchial occlusion due to tumor, obviously because of the accumulation of bronchial secretions within the involved segment of lung. In primary malignant disease of the lung, clubbing of the fingers or more extensive pulmonary osteoarthropathy appears to be associated with the occlusion of a bronchus to a considerable area of lung tissue and not with a secondary suppurative process.

Patients with unexplained pleural effusion require the same careful scrutiny recommended for those with hemoptysis. Unless the diagnosis of tuberculosis is confirmed by history, sputum, or x-ray, the fluid should be aspirated for guinea pig inoculation. The fluid is also to be examined for tumor cells, preferably by fixation and sectioning of the sediment. If a diagnosis cannot be established, recourse must be had to bronchoscopy, replacement of the fluid by air for further x-ray studies, thoracoscopy, or exploratory thoracotomy.

Decision as to Operability.—Until further evidence is at hand the final decision as to the possibility of removing the growth in certain cases can be determined only by surgical exploration of the chest. However, x-ray evidence may definitely show the futility of operation in advanced cases by indicating distant metastases, mediastinal involvement, bronchiogenic metastases in the contralateral lung or in other lobes of the same lung, extensive involvement of the chest wall or diaphragm, or a widening of the

angle formed by the two primary bronchi due to involvement of the hilum nodes.

Evidence obtained from bronchoscopic examination may indicate to some extent the degree of fixation of the growth, and will provide definite evidence regarding the level at which the lobe or lobes must be amputated to reach the upper limits of the tumor. A widening of the carina in the absence of distortion due to mediastinal displacement may be taken to indicate enlargement of the hilum lymph nodes. Visualization of the trachea and primary bronchi can be furthered by lipiodol injection combined with the insufflation of bismuth powder. While a definite diagnosis of neoplasm based on tissue removed at bronchoscopy is to be desired in planning a radical operation, this finding will almost certainly be lacking in early peripheral tumors.

Data are not available to permit a positive statement that pleural effusion indicates involvement of the visceral pleura with dissemination of the growth. An analogy with the ascites of abdominal carcinoma suggests that this relationship may hold.

Cases in which the tumor involves the left main bronchus should be studied to determine a possible involvement of the esophagus. A case has recently come under observation in which a positive biopsy was obtained at both bronchoscopy and esophagoscopy.

Because of the established frequency of metastasis to the brain, patients with pulmonary carcinoma should be subjected to a careful and searching neurologic examination before radical operation is considered.

Preoperative Preparation.—Careful attention is to be paid to the hygiene of the oral cavity to minimize the aspiration of infected material. Carious teeth are to be extracted and the gums allowed to heal. The mouth should be cleansed with an antiseptic solution on the day of operation.

The induction of an artificial pneumothorax for one to three weeks prior to operation is, I believe, a sound measure. When this has been done, a wide exposure of the pleural cavity seems to carry less of an insult to the cardiorespiratory mechanism. It is also theoretically possible that the mild inflammatory reaction of the pleura to air may diminish the dangers of infection.

During the past year I have been attempting to produce a specific as well as a nonspecific immunity to several strains of pneumococcus as a preoperative measure in major intrathoracic and upper abdominal cases. Any strain of pneumococcus that can be cultivated from the patient's nasopharynx is added to a mixed vaccine of virulent laboratory cultures. Injections of this vaccine are given at least one week and preferably two weeks before operation. There are no controlled clinical data that can be cited as support for this procedure, and it is brought to your attention merely as a proposed safeguard against pneumonia.

A temporary diaphragmatic paralysis is induced by crushing the phrenic

nerve on the side of the lesion at least one week prior to operation. It is interesting to note that this measure has in itself served to reduce cough and pain.

Operative Technic.—To minimize the hazards of air embolism the patient is placed upon the table in the Trendelenberg position. Unless contraindications to its use are present, avertin is recommended as an admirable anesthetic for intrathoracic operations. Respirations are shallow and the cough reflex is materially lessened. Avertin permits the use of the electrocautery on the lung, a procedure that is impractical with the employment of explosive anesthetic mixtures. Differential pressure is maintained by a stream of oxygen introduced through an intratracheal tube. In order to insure easy insertion of the tube under avertin anesthesia it is advisable to anesthetize the pharynx with cocaine as a preliminary measure. Nitrous oxide may be added to the oxygen as a supplementary anesthetic, particularly while making the incision in the chest wall. Explosions have been reported during the use of nitrous oxide-oxygen mixtures in closed systems and it is well to bear this in mind when operating with the electrocautery.

The use of the tightly fitting mask as a method of securing differential pressure in major intrathoracic operations has not been satisfactory in my hands and has been abandoned in favor of the intratracheal tube. The possibility of administering oxygen independent of the patient's own respiratory efforts insures the prevention of anoxemia, one of the chief hazards of intrathoracic surgery. A normal heart will readily meet an unusual strain if an adequate supply of oxygen is available, but may fail abruptly if subjected to strain and anoxemia in combination. A further advantage of intubing the larynx is that it insures the abolition of coughing and straining against a closed glottis.

The incision used is that described by Lilienthal and used by Harrington in his series of intrathoracic tumors. If the ribs are cut close to the spine, the sacrospinalis muscle group will overlie the vertical portion of the incision when the wound is closed.

In order to remove the group of bronchial lymph nodes lying nearest to the tumor, resection of a malignant tumor of the lung calls for removal of the entire lobe. The vessels supplying the lobe are to be isolated and separately ligated. As it has been demonstrated that the main stem of the bronchus to the right middle and lower lobes can be closed by primary union in the human subject, this method deserves further trial until it is proved impractical. Care should be exercised not to traumatize the wall of the bronchus; crushing or mass ligatures invite infection in devitalized tissue and may well explain certain tragic failures in the past. Absorbable sutures are recommended, as silk ligatures penetrating the bronchial mucosa have been observed to slough into the lumen and may well act as a foreign body in the respiratory tract. The closure of the bronchial stump

in lobectomy for carcinoma or bronchiectasis may be furthered by burying the stump in the surface of the adjacent lobe. The pleural cavity is not blessed by omentum, but lung tissue itself seems admirably suited for this purpose.

Before closing the incision a catheter is introduced in the costophrenic sulcus with a subcutaneous tunnel to provide air-tight drainage. As soon as further experience demonstrates the reliability of secure closure of the bronchus, I am quite prepared to omit the use of catheter drainage and rely upon aspiration if necessary to remove the accumulation of fluid. The dangers of tension pneumothorax and mediastinal emphysema that may attend a giving way of the bronchial suture are so grave (Sauerbruch) that it appears wise to continue with the catheter drainage for the present.

Postoperative Care.—The catheter in the chest is attached to a constant suction apparatus maintaining a gentle negative pressure of approximately six centimeters of water. If an attached manometer fails to record variations of pressure with respiration, the catheter is to be freed of blood clots by irrigation.

Following a major intrathoracic operation the patient is routinely placed in an oxygen tent. Subsequent observation is especially directed toward the appearance of respiratory embarrassment from mediastinal displacement. Coughing is controlled by the liberal use of pantopon or codeine.

SUMMARY

Four patients with clinically diagnosed primary carcinoma of the lung have been operated upon with proposed resection of the tumor. The growth was judged inoperable in two instances. One patient died of pneumonia four days after resection of the right lower lobe. In the fourth case the right lower and middle lobes were successfully resected and primary healing was obtained in the bronchial stump.

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DISCUSSION

DR. FREDERICK T. LORD (BOSTON).—The occasion should not be allowed to pass without comment on the importance of this presentation. In overcoming the technical difficulties of removing two lobes of the lung Dr. Churchill has broadened the scope of thoracic surgery. Apparent absence of metastases at the time of operation and the present satisfactory condition of the patient suggest that this case will go down in history as the first successful bilobectomy for bronchial carcinoma.

DR. EVARTS A. GRAHAM (ST. LOUIS).—I want to congratulate Dr. Churchill very much indeed on this brilliant case, but because the time is limited, I wish to say one or two other things without taking too much time in the congratulation.

Dr. Churchill indicated that the examination of pleural effusions in cases of carcinoma of the lung does not give much reliable information. That is true if one examines these effusions in the ordinary way. However, if one uses the method described by Mandelbaum about five years ago, he can often make an accurate diagnosis of a malignant tumor of the lung which could not be made by any other means. The method is exceedingly simple in application. It consists merely in centrifugalizing some of the pleural effusion, fixing the sediment in formalin, embedding it in paraffin in the usual way, and sectioning it as one would an ordinary piece of tissue.

Since we have used this method almost as a routine in doubtful cases of pleural effusion, we have picked up a large number of cases of previously undiagnosable carcinoma of the lung. We have had occasion to check up the method with negative findings and so far as I know in no case where there has been a negative finding has it been possible to demonstrate any metastases to the pleura. More than one examination, however, may be necessary to feel certain that the result is negative, just as is the case in the examination of the sputum for tubercle bacilli. In one instance in a case which later proved to be a tumor of probable thymic origin, the cells in the pleural fluid were considered to be lymphocytes instead of being recognized as true tumor cells. This error, however, should not be ascribed to the method. We feel, therefore, that the application of this simple method will tell us almost with certainty whether or not we are dealing with a case which has metastasized to the pleura.

There is one other aspect of this question which I suppose Dr. Churchill failed to mention because of lack of time; that is, it occasionally happens that a primary carcinoma of a bronchus can be removed successfully through a bronchoscope. We know of one patient who has been well for nearly three years after the removal of a primary carcinoma of a bronchus through a bronchoscope by Dr. Arbuckle of our group. The patient is a doctor who is actively engaged in general practice at the present time. I believe also that Dr. Chevalier Jackson successfully removed a similar carcinoma through the bronchoscope and that the patient was known to be alive two years later.

DR. RALPH B. BETTMAN (CHICAGO).—Some five or six years ago I presented to this Society some work I had done on the healing, or rather lack of healing, of large bronchi. This work was done on dogs.

I found that when I resected the entire lung and left an uncovered stump, that almost invariably no healing occurred. I found that, on the other hand, if I left one or two of the remaining lobes of the lung, healing invariably occurred. It is interesting to note that these two facts have been frequently quoted in the literature—one from the point of view that large bronchi will not heal and the other that they do heal.

The lesson I learned was this, that large bronchi will not heal unless there is other tissue besides the bronchial tissue to close the stump. The bronchial tissue itself is peculiarly inert. On the other hand, the tissues derived from overlying lung are capable of closing bronchi. To my mind, the remarkable success which Dr. Churchill has had and for which he is to be congratulated, is due to the fact that he has left at least one or two lobes of the lung in place.

DR. HAROLD NEUHOF (NEW YORK CITY).—The presentation of any case of successful excision of carcinoma of the lung is always a matter of great interest. A brief report of the ultimate result of a case operated upon by me a year or more ago will illustrate a viewpoint I wish to present. This patient upon whom I performed a lobectomy for a carcinoma of the main bronchus died, riddled with metastases, about six months after operation. I would contrast this case with two others in which there were much longer periods of survival after excision of carcinoma of the lung not derived from one of the main bronchi. This brings up, I think, the important question of the study of material for the purposes of selective analysis of cases that might or would be favorable for operation.

At the Mount Sinai Hospital in New York an analysis has been made of almost 100 patients suffering from primary carcinoma of the lung who came to autopsy. A full report on this material will be made. In conjunction with Dr. C. B. Rabin I have analyzed it briefly from the viewpoint of operability. The cases fall into three groups. First, carcinoma of the main bronchi comprise 30 or 40 per cent of the cases of carcinoma of the lung. Bronchoscopy is positive, early metastasis is the rule, and these cases do not as a group fall into the field of operability. It is important to differentiate carcinoma of a bronchus from adenoma which closely simulates carcinoma, but which is in fact not a malignant tumor and can be treated endobronchoscopically with satisfactory results.

Secondly, there are the carcinomas which have been termed peripheral and which are derived from the smaller bronchi. They comprise between 30 and 40 per cent of the cases. Here, too, bronchoscopy is positive, early and widespread metastasis is the rule, and radical removal is therefore rarely indicated.

The third group, comprising less than 10 per cent of the cases, is a group in which the tumor pathologically is probably derived from one of the very small order of bronchi. These tumors may be termed parenchymal carcinoma for purposes of topography. Bronchoscopy is negative, the x-ray picture is usually distinctive, and only local invasion occurs for a considerable period of time. Local extension is of course no obstacle to an effort at removal. It is in this group that the surgery of pulmonary carcinoma has the only real opportunity, as far as I can see, to offer ultimate results. Several months ago I operated upon one such patient. There was much more extension of the carcinoma outside the lower lobe than within it. The tumor had widely invaded the lower chest wall and diaphragm. At operation part of the lower lobe was excised together with parts of chest wall and diaphragm. The patient has done very well and is as yet free from any evidence of recurrence. A point of interest in this case, however, is that it belongs to the only group in which, in my opinion, one may anticipate worthwhile end-results.

DR. EDWARD ARCHIBALD (MONTREAL).—I would confine my remarks to this point, that the tumors of the stem bronchi and first divisions are more frequent than we have been thinking hitherto. Dr. Meakins, of the Royal Victoria Hospital, has just finished a short course of lectures in San Francisco, upon fifteen cases of this lesion which he discovered in our records.

Secondly, the diagnosis is apparently easy at an early date because such growths soon give rise to the symptom of unproductive cough, which leads necessarily nowadays to bronchoscopy, and so to diagnosis.

In regard to the technic, I am glad to see that Dr. Churchill emphasized the importance of preliminary pneumothorax, in order to stiffen the mediastinum. In a recent case in which I removed the whole of the left lung including the stem, in two stages, for a tumor which lay in the stem bronchus, I established an artificial pneumothorax at the time of a preliminary, exploratory thoracotomy, which was carried out in order to make sure of operability in respect to metastases in the lymph glands of the hilus, in the pleura, or elsewhere. I might add, very briefly, that no metastases were found, that the lower lobe was later excised for the condition of suppurative bronchiectasis, due to obstruction by the tumor, and that finally the upper lobe, together with the stump of the lower lobe and the stem bronchus, from a point about one inch from the bifurcation, was later removed through an anterior approach. This was accomplished without undue difficulty, and, so far as respiration and the heart action were concerned, without any serious upset, either during operation or in the succeeding days, a fact which I attribute to the stabilization of the mediastinum by the preliminary pneumothorax. The patient unfortunately died on the fourth day after operation, from an acute streptococcal septicemia, undoubtedly coming from a very small empyema cavity resulting

from the lower lobe infection and the first lobectomy. I feel convinced, from this experience, that it would have been better to remove the whole lung in one stage, through an anterior lateral incision, by the same technic as employed for the second stage, provided that the mediastinum is first stabilized by an artificial pneumothorax. When secondary infection in a lung complicates such cases of tumor of the main bronchus, and particularly when there are very extensive and very dense pleural adhesions to separate, the degree of shock may be so great as to prevent one's carrying through the whole operation in one stage. Under these circumstances the high spinal anesthesia, used by Shenstone for his lobectomy, may prevent shock and render possible the one-stage operation. The empty half of the thorax must be accepted as a permanent sterile pneumothorax, and I see no insuperable difficulty in securing a permanent closure of the stem bronchus in cases where there is no serious infection.

Therefore, it is probable that an extension of Dr. Churchill's method from one lobe to both lobes is perfectly possible, when such a radical operation seems necessary, and that it has a good chance of removing everything before the glands are involved. Meanwhile, it is a pleasure to congratulate Dr. Churchill upon the splendid result of a difficult operation, courageously conceived and skillfully carried out. We shall await with the greatest pleasure the publication of the complete report, of which, owing to the time limit, he has been able to present today only an abstract.

DR. CARL A. HEDBLOM (CHICAGO).—Dr. Churchill is to be congratulated on having successfully performed a total lobectomy for carcinoma, even if the patient should develop recurrence. In all the cases I have explored, so far, the growth had infiltrated the hilum so extensively that total extirpation was out of the question. In several such cases I have inserted radon seeds directly into the tumor. All the patients so treated were materially relieved. One patient lived nearly two years and looked after her housekeeping duties until within a week of her death.

DR. EDWARD D. CHURCHILL.—Our laboratory has not had as extensive experience in dealing with pleural effusions as Dr. Graham's. Undoubtedly this explains the fact that we were unable to find tumor cells in the pleural effusion by sedimentation and microscopic examination of the fluid obtained by thoracentesis in the first case cited.

In summarizing the points in my paper, I feel that the presence of carcinoma in a lobe of the lung demands the removal of the entire lobe rather than the portion of the lobe containing the tumor.

I should emphasize that the stump of the bronchus is to be treated with great gentleness. A bronchial stump should not be crushed, as to do so means leaving a nidus of devitalized tissue within the respiratory tract.

The principle that I believe will help us most, both in lobectomies for carcinoma and in the single stage lobectomies for bronchiectasis is a careful implantation of the end of the bronchus into the tissue of adjacent lobes.

How Dr. Archibald provides for primary closure when he takes out the entire lung, I would be interested to know. It is important to learn if the main bronchus will stay closed following complete pneumectomy.

SOME OBSERVATIONS UPON THE VALUE OF BRONCHOSCOPY IN THE TREATMENT OF BRONCHIECTASIS* †

DAVID H. BALLON, M.D.
MONTREAL, CANADA

THAT the bronchoscope renders a distinct service in the diagnosis of bronchiectasis is now more or less universally accepted. The value of bronchoscopic aspirations of secretions preliminary to such operations as lobectomy and thoracoplasty and after the latter procedure is also acknowledged by those who are alive to the fact that the spilling over of secretions into the opposite lung or the retention of secretions in the compressed lung may in such cases prove fatal. Many are loath to admit, however, that bronchoscopy accomplishes more than most recommended forms of treatment, and yet few will deny the fact that postural drainage accomplishes much. I believe that the bronchoscopic treatment of bronchiectasis is the best of the conservative means at our disposal for establishing adequate drainage.

Many patients suffering from mild bronchiectasis due to foreign bodies or bronchostenosis, whose conditions are recognized early, can be relieved if adequately treated early. It is appreciated, however, that the continued presence of any form of bronchial obstruction will eventually lead to bronchiectasis and worse still to bronchiectasis plus abscess formation. The bronchoscope accomplishes little in the presence of the latter.

We are concerned chiefly with those patients suffering from the non-obstructive forms of bronchiectasis. At the present time the ideal treatment in such cases calls for the removal of the diseased bronchi and lung tissue. Such operations are still associated with a definite operative mortality but can effect a complete cure.

It is not my desire to compare the results obtained by bronchoscopy with those obtained by the accepted surgical forms of treatment. My purpose is merely to record what has happened to some patients with bronchiectasis, who were treated bronchoscopically. Practically all these patients received lipiodol injections. I have treated over 125 patients with bronchiectasis bronchoscopically. Only 62 cases have been recorded here. The treatments have consisted of:

1. The removal of obstructions to drainage, (granulations, dilating stenosed bronchi).
2. Aspiration of pus.
3. Local medication.

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*From the Bronchoscopic Clinic of the Royal Victoria Hospital, Montreal.
†Read at the Fifteenth Annual Meeting of the American Association for Thoracic Surgery at Ann Arbor, Michigan, April 18, 19, 20, 1932.

1. The removal of mechanical obstructions to drainage reduces the inflammatory swelling and edema of the mucosa.

2. The aspiration of thick viscid pus permits ciliary action, thereby facilitating better drainage; the quantity of the sputum is reduced and its offensive odor lessened.

3. The local application by swab of such medicaments as silver nitrate, 5 per cent solution; argyrol, 20 per cent solution; zinc chloride, 1/10 of 1 per cent solution, etc., or the instillation of some oily preparation, such as gomenol, helps to protect the mucous membrane from further irritation by pus. Mineral oils are nonirritating and are the only ones to be used in the lung. Vegetal substances should never be used, as they start up a violent reaction in the lung.

I have noted no greater improvement after the combined treatment of aspiration with lavage than from simple aspiration alone. On the contrary, I have seen two patients develop pneumonia after bronchoscopic lavage.

TECHNIC OF BRONCHOSCOPIC TREATMENT

I prefer to give bronchoscopic treatments in the morning. After the diagnosis is established, the bronchoscopic treatment may be preceded by postural drainage. Postural drainage is in some instances as effective as bronchoscopic drainage. When this is found to be the case, the latter may be dispensed with, but periodic bronchoscopic aspirations even in such cases should be considered in the individual case. In children there are no preliminary preparations. No breakfast is given, and no anesthetic, local or general, is used.

Adults are sometimes given a preliminary hypodermic injection of morphia, gr. 1/4, and atropine, gr. 1/150. Pantopon is substituted for morphia when the latter is not tolerated. A local anesthetic of 10 per cent or 20 per cent cocaine with a few drops of adrenalin is used to anesthetize the larynx, and if indicated a 2 per cent solution of cocaine is applied on a swab to the bifurcation when the bronchoscope is passed. As already noted, the bronchial tree is inspected for abnormalities and the purulent secretion is traced to its source. If pus is present in both main bronchi, it is important to decide whether one or both lungs are infected, for pus from the infected lung frequently flows over into the normal lung. Uncontaminated cultures can be taken, and if necessary autogenous vaccines prepared.

The youngest patient in the group of 62 cases here recorded was three years old; the oldest sixty-eight. The lesion was bilateral in 7 cases. The results are not nearly as good when the lesion is bilateral, but there are exceptions.

The number of treatments varied with the type of case and the response. Some patients received over seventy treatments; in others two or three sufficed. The fact that numerous treatments may be necessary does

not detract from the method, since the disease is in many instances worse than pulmonary tuberculosis.

NO. PATIENTS	OBSERVED	ALIVE AND ACTIVE	NOT IMPROVED	DEAD	RESULT UNKNOWN
5	prior to 1924	3	2		
18	between 1924 and 1926	10	4	1	3
27	between 1926 and 1928	17	5	1	4
12	between 1928 and 1930	7	2	1	2

Four of the 62 patients were operated upon; 3 died, 1 was cured. These patients all suffered from the more severe forms of bronchiectasis. It is only fair to say that 1 of them had 5 bronchoscopic treatments and that all the others had less. At least 2 of these patients would, in all probability, have died irrespective of the form of treatment. It is perhaps fair to assume that those patients in whom the results are unknown and who have been lost sight of are dead.

It may be argued that since most of the patients suffered from unilateral disease that perhaps they would have done just as well had they been allowed to carry on without any form of treatment. This is precisely the point which this paper wishes to make. Up to the present time we have no right to assume that their lives would be prolonged if they were subjected to an operation of some sort. It is suggested that perhaps bronchoscopic treatment prevented some of them from developing the more serious complications and perhaps prevented the condition from progressing in a few. The bronchoscopist should not treat patients with severe bronchiectasis indefinitely, since it is acknowledged that some such patients may be cured by the cautery pneumectomy (Graham) and by lobectomy. Reference to the type of lesion and to the extent and severity of the bronchiectasis in the individual cases will be made in detail at another time.

SUMMARY

Some experiences with bronchoscopy in the treatment of 62 patients suffering from bronchiectasis have been recorded. They lead one to suggest that the condition is not always progressive. The more severe forms of bronchiectasis call for surgical interference.

CLOSED INTRAPLEURAL PNEUMOLYSIS IN THE ARTIFICIAL PNEUMOTHORAX TREATMENT OF PULMONARY TUBERCULOSIS* †

JAMES HEDGES FORSEE, M.D.‡
DENVER, COLO.

THE fundamental principle in the treatment of chronic, far-advanced, pulmonary tuberculosis is the closure of cavities;[1, 2, 3] and to this end cauterization of adhesions by closed intrapleural pneumolysis as an adjunct to artificial pneumothorax is of greatest importance. Artificial pneumothorax is the most valuable single method of obtaining rest for the tuberculous lung. Unfortunately, pleuritic adhesions prevent about 50 per cent of the cases needful of pneumothorax treatment from receiving its maximum benefit.[4, 5, 6] In approximately 10 per cent of the cases, the pleural surfaces are sufficiently adherent to prevent the induction of air. Of the remaining 30 to 40 per cent, satisfactory compression is obtained except in localized areas where adhesions preclude compression and cavities remain patent. About one-third to one-half of this latter group are suitable cases for closed intrapleural pneumolysis.[5, 6]

Closed intrapleural pneumolysis is an operative procedure for the severing of adhesions between the partially collapsed lung and the parietal pleura. The method was originally devised by H. C. Jacobaeus of Stockholm, Sweden, whose original method, with two notable modifications, is now in common usage.[7] First, Unverricht, in 1922, improved the Jacobaeus thoracoscope by equipping it with a Zeiss system of lenses, thereby improving its field of vision.[6] Second, is the use of the high frequency current to replace the galvanocautery for cutting the adhesions. Herve[9] reported the use of this method in 1922. Ralph C. Matson,[6] of Portland, Oregon, has recently devised an ingenious set of electrodes for use with the Bovie electrosurgical unit. His excellent results have done much to establish this method definitely. This latter modification has notably decreased the number and severity of operative and postoperative complications. It has also enlarged the field of usefulness of the operation by being able to apply the method to more difficult cases.

The purpose of this paper is to present a brief review of the literature, together with a critical analysis of 28 cases at Fitzsimons General Hospital,** in which thoracoscopy was carried out with cauterization of adhe-

*From the Surgical and Medical Services, Fitzsimons General Hospital, Denver, Colorado. Read before the Denver Sanatorium Association April 26, 1932.

†Published by permission of the Surgeon-General, U. S. Army, who is not responsible for any opinion expressed or conclusion drawn herein.

‡Captain, Medical Corps, U. S. Army.

Received for publication September 6, 1932.

**One case was operated upon by Ralph C. Matson, Portland, Oregon; 10 cases were operated upon by H. V. Raycroft, Major, Medical Corps, U. S. Army. In several of the earlier cases the cystoscope and ordinary galvanocautery were the instruments used.

sions in 26 cases. The first patient was operated upon in September, 1927, and until November, 1930, 10 patients had been operated upon; in the past twenty months, 16 patients have undergone cauterization.

The primary purpose of closed intrapleural pneumolysis is to convert an unsatisfactory pulmonary collapse into a satisfactory one by severing adhesions. The value of such a procedure must be considered in the light of other procedures, which may be used to accomplish this purpose. Two methods, other than closed intrapleural pneumolysis, are applicable. The first method is the stretching of adhesions through the use of high intrapleural pressure. Suffice it to say that, according to Matson,[6] superimposed spontaneous pneumothorax is 40 per cent more frequent in cases in which such a procedure is used. Pleural effusion is considerably more frequent with positive than with negative intrapleural pressure. We have occasionally found it necessary to use high pressure in the preoperative preparation in order to obtain adequate space for manipulation of the instruments. Such a procedure is carried out judiciously and for a comparatively short time. Positive pressures may also be gradually applied after the adhesions are severed in cases with thick, fibrotic walled cavities.

The second available method is the cutting of adhesions by open pneumolysis, which consists of the removal of a portion of one or more ribs, opening the parietal pleura and cutting the exposed adhesion. Such a procedure has its appealing feature in that it is a clean-cut surgical procedure, not requiring the interpretation of images.[10, 11] Carter[10] has recently reported good results in 4 cases treated by modified open pneumolysis. He cuts away the parietal pleura at the chest wall attachment, peeling the pleura and adhesion off in one piece. This procedure is not free from such grave dangers as mediastinal flutter, altered intrapleural pressure bilaterally, and empyema;[12, 13] finding disfavor among those familiar with the technic of the closed method. Literature contains few case reports of the open method and no single article contains as many as 20 cases.[10] Already, over one thousand cases of the closed method have been reported,[5 to 9, 13 to 20] and such a comparison would influence the impartial observer to accept the closed method as the more desirable.

INDICATIONS

It is evident that a pneumothorax with sufficient space for instruments is a prerequisite for operation. Thus, a patient under consideration for operation has previously presented the necessary indication for artificial pneumothorax.

Essentially, a discussion of operative indications should include indications for thoracoscopy and indications for cauterization. The difference is fundamental in that the indications for cauterization are entirely dependent upon the thoracoscopic findings. Results will, to an appreciable ex-

tent, depend upon the experience and judgment exercised in the selection of adhesions for cauterization at the time of thoracoscopy. Experience allows accurate orientation and proper interpretation of the thoracoscopic findings. Cases in which thoracoscopy is indicated may be conveniently divided into three groups as suggested by Matson.[7] First, those with an unsatisfactory pneumothorax due to the presence of adhesions preventing compression of the most desired areas. Second, those having sufficient compression in spite of adhesions, although a high intrapleural pressure is required to maintain the collapse. Third, those of unsatisfactory pneumothorax due to the fibrous organization of adhesions, with contraction and resultant pulling out of a once satisfactorily compressed lung and reopening of cavitation.

The result to be expected from pneumothorax treatment is usually ascertainable after a few months. If, after this time, x-ray study shows that the cavity is not definitely decreasing in size, and the twenty-four-hour quantity of tubercle-bacilli-laden sputum is not decreasing, it is reasonable to assume that the desired compression is not being obtained. The use of high intrapleural pressure may produce distressing symptoms and the usual attendant dangers of high pressure must be considered.

Thoracoscopic examination may reveal adhesions unsuitable for cauterization, either complete or incomplete. Under such conditions the adhesion may be coagulated at its parietal attachment, permitting the stretching of the adhesion to achieve the desired lung compression.

The third group would include cases of an expanding pneumothorax, in which x-ray study did not show the presence of adhesions; although a tented contour of the partially collapsed lung suggests their presence. Thoracoscopy is indicated, as severance of the adhesions will relieve the symptoms and reduce the degree of pressure necessary to maintain a satisfactory collapse. The presence of adhesions, per se, is not necessarily an indication for operation. They must be interfering with a satisfactory collapse.

A fourth indication for thoracoscopy is suggested as a logical procedure prior to open pneumolysis. Information as to the exact localization of the adhesions, together with the study of their size and character would be valuable data to precede rib resection. Further, the adhesions might be found suitable for cauterization or the lung might be found so adherent as to preclude either operative procedure.

CONTRAINDICATIONS

We have recognized no contraindications to thoracoscopy if the indications just enumerated are present. The presence of a bilateral pneumothorax only makes the procedure more urgent. We have had no cases in the past two years of pyopneumothorax in which thoracoscopy was indicated. However, a chronic, afebrile, purulent exudate would not be a

contraindication. In an acute, purulent exudate, with fever, the procedure would be contraindicated. We have operated in the presence of febrile collections of serous exudate with beneficial results. The tuberculous disease may be so extensive that apparently little hope of recovery exists, even though the adhesion be severed. Since thoracoscopy is essentially free from danger, the patient should be given the benefit of this procedure with cauterization of suitable adhesions, if his immediate physical condition permits.

SELECTION OF CASES

The cooperation of the phthisiologist, roentgenologist, and surgeon is necessary in the proper selection of cases for operation. The meticulous study of serial stereoscopic chest x-ray films before and during the course of pneumothorax is obligatory. Interpretation of roentgenograms showing apical adhesions are more difficult than are those showing laterally attached adhesions. At times it is questionable from stereoscopic study whether we are dealing with adhesions or adherent lung and to what extent both are present. This is especially true of the lung apices where the indeterminable character of the apical attachments may call for thoracoscopic examinations to determine the true condition.

The lateral attachments of the floor of a large cavitation in the upper lobe, with an induced pneumothorax below, may closely simulate a lateral adhesion. Cutting into the floor of such a cavity has been reported,[5] with the liberation of its contents. If x-ray study fails to make the differentiation clear, lipiodol should be injected into the known pneumothorax space. Fluoroscopic observation is then carried out to determine if any of the oil enters the questionable pneumothorax. If it does, it indicates that the lateral densities are adhesions and not the floor of a cavity.

Roentgenographic study alone cannot be used to determine the number, width, or thickness of adhesions. It is not possible, roentgenologically, to determine whether the edges or the entire width of the adhesion is shown. The anterior border of a wide band or fold adhesion may appear as a dense cord, the posterior and heavier folds may appear as other distinct cords giving the impression of multiple, small cord adhesions. In other instances, only the anterior border may be of sufficient density to show, yet the adhesion be rather wide. Often many small adhesions may not be shown on the roentgenogram, while others of greater density may be hidden by bony structures. However, the roentgenogram is of utmost value in the study and selection of cases as well as in determining the site for introduction of the thoracoscope.

TECHNIC

The operative technic need not be described in detail, as it has been ably described by its originator.[8] The technic which we have found most valu-

able and have used in the last 14 cases of this series is the electrosurgical method as presented by Ralph C. Matson.[6] As an addition to his preoperative preparation we have used sodium amytal, three grains, the night before and repeated one hour before operation. We have found this a valuable adjunct in decreasing the patient's apprehension and nervousness.

At this point it is well to classify the adhesions which may be encountered. Jacobaeus arbitrarily classifies three groups: first, those adhesions having a thoracic attachment above the second rib are called apical; second, those having an attachment below the second rib to the diaphragm are called lateral; and third, diaphragmatic adhesions. Adhesions comprising the first group are by far the most difficult to cauterize. This is due to the fact that the mobility of the lung is here rather limited and comparatively little tension is placed upon these adhesions, with the result that little space is provided for cauterization and the danger of injury to the lung is great. We have found adhesions in this location more generally broad bands or diffuse folds with indistinct blending of the grayish-blue lung parenchyma with its coal pigment and the grayish-red adhesion containing numerous small blood vessels in its surface.

Jacobaeus reports 90 per cent of his first 50 cases as being of the lateral type. In our series, 11, or 42 per cent, were situated primarily above the second rib; in 15, or 58 per cent, the adhesions were lateral. We have not cauterized any diaphragmatic adhesions.

A classification of adhesions according to size and shape is suggested by Matson.[6, 7, 21] String adhesions result from a recent pleuritis and are usually of little technical importance, although adhesions no larger than ordinary catgut suture may be sufficient to prevent the satisfactory collapse of the lung. Cord adhesions are generally about the size of one's small finger and are often of clinical importance. Band adhesions vary in thickness from a few millimeters to 1 cm. and are from 1 to 10 cm. in width. Fan-shaped adhesions have a narrow pulmonary attachment with a broad thoracic attachment. The edges are fibrous, with a thin membrane between, and are easy to cauterize with the transition between the lung and the adhesion clear. Funnel- or cone-shaped, adhesions have a broad visceral attachment with a small circumscribed thoracic attachment. They frequently occur over superficial cavities and often contain prolongations of the cavity. The transition between the lung and adhesion is not clear and troublesome blood vessels are often encountered, requiring cauterization close to the parietal pleura. Spool-shaped adhesions are an admixture of the fan- and funnel-shaped type, having both broad visceral and thoracic attachments narrowing somewhat in the middle. Fold or curtain-like adhesions originate from an interlobar pleuritis which extends to the parietal pleura. Following pneumothorax treatment the lung is partially compressed and the adhesions take on a curtain-like appearance. They are usually situated in the costovertebral gutter, in the apex, or at the site of

the interlobar fissure and are of technical importance but often unsuitable for cauterization. Diffuse fold adhesions result from a more generalized pleuritis, with the lung often very close to the chest wall and extensions from the main adhesion may radiate in all directions. Technically, they are very important, being the type in which partial cauterization finds its greatest usefulness. At times only the free edge can be cut which may result in a satisfactory collapse.

At thoracoscopy, the thorascope is moved about in all directions so as to view the entire pneumothorax space. The vascularity of the pleura is observed. It may be considerably injected and edematous indicative of an acute pleuritis. Cauterization in such cases will aggravate the pleurisy with the production of severe pain, effusion, and possibly an obliterative pneumothorax. Fibrin deposits and tubercles, varying from isolated minute tubercles to conglomerate areas, appearing as grayish-white raised areas on the visceral or parietal pleura or upon the surfaces of the adhesions, may be seen. Unfavorable complications, such as empyema or superimposed spontaneous pneumothorax, are apt to result following cauterization in such case, due to activation with subsequent rupture of subpleural tubercles. Oleothorax as a substitute for the pneumothorax may prevent the development of an empyema. If multiple adhesions are present, it may be quite impossible to determine accurately which are technically the more important. In the presence of one or two string adhesions and a large band or fold, it is best to cauterize the smaller ones first in order to avoid increased tension and tearing the string adhesions at their lung attachments, with concurrent bronchial fistula.

Adhesions will generally not be difficult to locate, but it must be borne in mind that the size of the structure examined will vary directly with the distance from the thoracoscope. Correct orientation is thus very necessary. All the adhesions should be carefully studied. The transition between lung and adhesion is often indistinct in band, funnel, and fold adhesions. In the presence of a thickened pleura, or a recent pleuritis, the distinction may be impossible and in these cases, to cauterize other than small adhesions is a very risky procedure. All sides of the adhesion should be studied before cauterization. One exception has been made; namely, in those band- or fold-shaped adhesions which become blended with the adherent lung, incomplete cauterization may be done by severing the free edge. Adhesions of this type have been found usually apical and posterior.

The site for introducing the electrode is selected by making pressure upon the interspace to locate the exact site of the adhesion attachment. In cases without a thickened pleura, the contents of the intercostal space will be seen to bulge when viewed through the thoracoscope. The site selected is anesthetized by an assistant while the operator observes the area through the thoracoscope and directs the assistant in introducing

the trocar cannula through the anesthetized area. It is our policy to introduce a second thoracoscope through this opening to further study the adhesions. Often a blunt electrode is introduced through this second opening to lift up the adhesion to facilitate thoracoscopic study. The operating electrode is then introduced through the cannula of nonconducting material. In the majority of cases the electrode will be introduced in the anterior axillary line, this being desirable, as the interspaces are wide thus allowing greater space for manipulating the instrument. In apical adhesions, with the thoracoscope in the second intercostal space, anteriorly, the electrode is advantageously introduced higher in the axilla. The electrode is guided onto the adhesion under thoracoscopic vision. Only experience in selecting the correct site for introducing the electrode will lessen this difficulty.

The point for cauterization is decided upon by thoracoscopic study. In large adhesions, it is generally safer to cauterize near their thoracic attachment, though greater pain will be experienced. The cauterization should be carried out slowly, being preceded by adequate coagulation along the area to be cut and extending into the substance of the adhesion, if necessary. After the adhesions are severed, the cut ends will be seen to contract, especially the portion attached to the lung. The lung will be seen to collapse further, unless held out by additional adhesions. Prolonged cauterization is to be avoided, but with the electrosurgical method the time required will seldom exceed forty-five minutes. Following cauterization, the pneumothorax cavity is again surveyed and if no hemorrhage from the severed adhesions is present, the instruments are withdrawn and incisions closed with silkworm gut. Firm adhesive strapping, similar to that used in thoracoplasty cases, is applied to minimize subcutaneous emphysema.

The immediate operative dangers are hemorrhage and damage to the lung parenchyma. Pleural adhesions receive their blood supply through collateral vessels from the intercostals. String, small cord, and fan-shaped adhesions do not contain troublesome vessels. The transition between lung and adhesion is clear; thus, the danger of lung injury in severing such adhesions is slight. In other types of adhesions, the transition may be indistinct and dangerous hemorrhages arise from perforation of the lung with severance of an artery. Intercostal vessels may be injured when cauterization is carried out close to the parietal pleura beyond the termination of the internal intercostal muscles.

Alarming hemorrhages have occurred from severing the large vessels within the adhesion.[6, 8] Perforation of the subclavian vessels has been reported[14] and indicates faulty orientation. Troublesome hemorrhage is apt to smear the lense of the thoracoscope, making it difficult to discover the origin of the bleeding. If its origin can be determined, Matson's electrodes are valuable instruments in controlling hemorrhage by coagulation.

Should this fail, a high intrapleural pressure should be produced by filling the pneumothorax cavity with normal saline solution.

Damage to the lung parenchyma results from technical errors. Case reports of opening into the floor of a cavity mistaken for adhesions are available.[5] More frequent is the cauterization of lung tissue contained as the prolongation of a cavity into an adhesion. Kremer[14] reports 3 such cases with fatal termination, all having extreme bilateral disease. The incomplete cauterization due to technical difficulty has, in 2 of our cases, been followed by a superimposed spontaneous pneumothorax due to the tearing of the partially severed adhesion, during an attack of coughing, with rupture of the lung. Cauterization carried out in close proximity to large blood vessels may produce a thrombosis. Painful neuritis and severe shock may result if the nerve trunks are injured.

Since February, 1931, we have used the electrosurgical method in preference to the galvanocautery. The advantages of this method are: first, more adequate coagulation is possible to prevent or control hemorrhage; second, less heat and smoke are produced, decreasing the amount of reaction at the site of cauterization; third, postoperative complications, such as empyema and pleurocutaneous fistula, are decreased, the latter being due to the heat that is produced in the shaft of the galvanocautery damaging the lung and chest wall; fourth, manipulation of the electrode within the thorax is less difficult than is the handling of the rigid cautery.

Postoperative care calls for the cooperation of the phthisiologist in carrying out the pneumothorax therapy diligently. Sedatives, including morphine, for twenty-four to seventy-two hours, in amounts sufficient to control coughing are required to minimize the loss of pneumothorax. Absolute bed rest, with the operated side up, or patient lying on his back with sand bags on the operated side, is maintained for two or three days, after which time the sandbags are removed, but absolute bed rest is continued as long as the physical condition necessitates. A satisfactory x-ray film is obtained at the end of from twenty-four to forty-eight hours and pneumothorax refill given if expansion of the lung has occurred. Small, frequent refills with negative pressure is desirable as a positive pressure favors subcutaneous emphysema, increases the tendency to form fluid and tearing of the incompletely cauterized adhesions. Too rapid compression of the cavity may result in impaired drainage of the lung cavity due to the kinking of its bronchus.[7] Subsequent refills carefully checked by x-ray study are given as required. The sutures are removed at the end of six to eight days and wounds are dressed as required. Pneumothorax therapy is then carried out as indicated. Positive pressure may be resorted to in order to close long standing fibrotic walled cavities, if fluid does not develop. The amount of sputum in twenty-four hours is a fair index to the compression being obtained. In successful cases the quantity decreases rapidly, often one-half to one-third the preoperative amount within one

week. Further postoperative care depends upon the treatment of complications that may occur.

COMPLICATIONS

Postoperative complications vary almost directly with the clinical condition of the patient and the character of the adhesion severed. In patients suffering from extensive tuberculosis, the cauterization of a small cord adhesion may be sufficient to produce a severe pleuritis and effusion, while patients with unilateral lesions may withstand a complicating pyogenic empyema requiring extensive thoracic surgery to obtain later an arrestment of their disease. Kremer[14] reports 22 per cent good results in 14 cases of extensive tuberculosis as compared with 66 per cent good results in patients with unilateral disease.

Subcutaneous emphysema was a troublesome feature in only 1 of our cases, with air extending into the abdominal wall and scrotum.

TABLE I

COMPLICATIONS—NUMBER OF CASES: 28*

	BEFORE OPERATION	AFTER OPERATION
Serous exudate	6	16
Tuberculous empyema	0	2
Pyogenic empyema	0	6†
Superimposed spontaneous pneumothorax	1	4
Obliterative pneumothorax	0	1
Secondary major thoracic surgery	0	5
Pleurocutaneous fistula	0	2
Hemorrhage (moderate)	0	1

*Number of thoracoscopies with cauterization of adhesions: 35.
Number of thoracoscopies without cauterization of adhesions: 4.
†Three cases had extensive involvement with bilateral cavitation.

Pleural effusion, sufficient to warrant a diagnosis preoperatively, was present in 6 of the 28 cases (see Table I). Following operation, the number increased to 16, or 36 per cent. In one case, 1500 c.c. of fluid were removed twenty-four hours before the operation and aspiration three times since cauterization has been required. It has now been five months since the operation. Of the 16 cases, 2 developed a tuberculous empyema requiring radical surgery. One patient accepted such procedures as recommended and is now leading a fairly normal life; the other declined such recommendations and died ten months after operation with extensive amyloidosis. Six patients developed a pyogenic empyema. Two cases occurred after the electrosurgical technic had been adopted; 1 resulted from the tearing of an incompletely cauterized adhesion with rupture of the lung; the other developed after cauterizing a 2 cm. band adhesion. Both patients had extensive cavitation bilaterally. Three of the 6 patients recovered following complete thoracoplasty and unroofing of the empy-

ema cavity; 2 patients had extensive tuberculosis and died within three months; the remaining patient is under oleothorax treatment. In 1 case, a severe pleuritis and effusion resulted in an obliterative pneumothorax which was under oleothorax treatment for six months, after which time the patient abandoned the hospital.

Superimposed spontaneous pneumothorax followed operation four times. These were divided equally between the galvanocautery and the electrosurgical method. The latter followed incomplete cauterization of large fold adhesions; while in the former, the rupture of subpleural tubercles and the rupture of an uncut string adhesion were the immediate causes. In one case, incomplete cauterization of a large laterally attached fold adhesion, carried out in two stages, was followed by a superimposed spontaneous pneumothorax and death ten days after operation. Of the other 3 patients, 2 died within three months from a pyogenic empyema and excavation in the contralateral lung; the other patient developed a tuberculous empyema and died eleven months postoperatively of generalized amyloidosis.

In two patients, a pleurocutaneous fistula developed at the site of introduction of cautery into chest wall. Both patients recovered after extensive surgical collapse with unroofing of the empyema cavity. In one patient, a moderate hemorrhage followed cauterization by galvanocautery.

RESULTS

The converting of an unsatisfactory pneumothorax into a satisfactory one, with decrease in the size of the cavity and the amount of sputum, was accomplished immediately in 16, or 61.5 per cent, of the 26 cases in which cauterization was carried out (see Table II). Seven cases, or 27 per cent, were technically successful but clinically unsuccessful due to extensive disease or complications which interferred with the clinical improvement. Three cases, or 11.5 per cent, were clinically and technically unsuccessful, incomplete cauterization being carried out in 2 of the cases. Two patients, in whom treatment was technically unsuccessful, due to incomplete cauterization, have had satisfactory clinical improvement. Two patients showed, on thoracoscopy, adhesions unsuitable for cauterization and in one of these the cavity closed following phrenic neurectomy and a continuance of pneumothorax. In the other case, coagulation of the parietal pleura about the attachment of the adhesion was carried out, allowing the stretching of the adhesions with moderate clinical improvement.

It is noted that in 18 of the cases, string, cord and fan-shaped adhesions were encountered. Of this number, 13, or 72 per cent, resulted satisfactorily while only 3 of the 8 cases, or 38 per cent, presenting folds or large band adhesions, resulted satisfactorily. In 65 per cent of the cases more than one adhesion was severed. Two patients underwent cauterization twice; in 1, four cauterizing operations were done. Of the 14 cases treated

by the electrosurgical technic, 10, or 71 per cent, were technically and clinically successful, as compared to the 50 per cent treated by the galvanocautery method.

Death due to the progression of the disease has occurred in 3 of the 28 cases. The operative procedure unfavorably influenced the clinical

TABLE II

CLOSED INTRAPLEURAL PNEUMOLYSIS—26 CASES

RESULTS OF OPERATION	NUMBER OF CASES	FOLDS OR LARGE BANDS	STRING, CORD, FAN	TOTAL PERCENTAGE OF CASES
Technically and clinically successful (satisfactory pneumothorax immediately with decrease in size of cavity and amount of sputum).	14	1	13	53.8
Technically unsuccessful, clinically successful. Incomplete cauterization.	2	2		7.7
Total, clinically successful.	16	3	13	61.5
Technically successful, clinically unsuccessful due to complications.	7*	3	4	26.9
Technically and clinically unsuccessful. Two incomplete cauterizations.	3	2	1	11.5
Cauterized by electrosurgical method.	14	5	9	
Technically and clinically successful.	10	2	8	71
Cauterized by galvanocautery method.	12	1	11	
Technically and clinically successful.	6	1	5	50
Death within 10 days after operation.	1	1		
Death due to independent evolution of tuberculous disease not related to operation.	3			

*Three cases had extensive pulmonary involvement with bilateral cavitation.

course, hastening death in 3 cases. In 61.5 per cent of the cases in which adhesions were severed, the clinical course was favorably influenced and arrestment of the disease will be in a large measure due to the severing of the adhesions. The prognosis in all of the cases at the time of the operation was poor, some hopeless; thus, if 61.5 per cent were benefited, including adhesions of all varieties, the procedure merits careful consideration.

CONCLUSIONS

A review of the literature and a critical analysis of 28 cases in which thoracoscopic examination and cauterization of suitable adhesions was carried out warrants the following conclusions:

1. That closed intrapleural pneumolysis is often a necessary adjunct in the artificial pneumothorax treatment of pulmonary tuberculosis.

2. That 61.5 per cent of the 26 cases treated by cauterization of pleural adhesion by closed intrapleural pneumolysis were favorably influenced in their clinical course.

3. That postoperative complications vary almost directly with the clinical condition of the patient and the type of adhesions cauterized.

4. That the electrosurgical method of closed intrapleural pneumolysis decreased the number and severity of operative and postoperative complications by adequate coagulation of the adhesions prior to their severance and by lessening the amount of heat and smoke liberated during cauterization. It is, therefore, superior to the galvanocautery technic for cutting pleural adhesions.

CASE REPORTS

CASE 1.—H. F. A., a soldier, aged twenty-five years. Patient diagnosed active pulmonary tuberculosis in Panama Canal Zone in July, 1929. Admitted to Fitzsimons

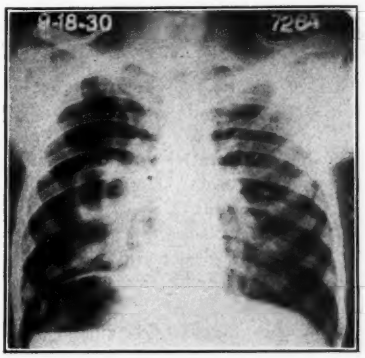

Fig. 1.—Case 1.

General Hospital September 9, 1929, with a 2 cm. cavity at the fourth rib level, left. Phrenic exeresis, left, November 26, 1929. Patient abandoned hospital February 4, 1930, and readmitted in July, 1930. The cavity had increased to 4½ cm. in diameter with a 2 cm. cavity at the first intercostal space, left. Artificial pneumothorax, left, induced August 5, 1930 (Fig. 1). After three months, the large cavity had been reduced considerably in size but remained patent with positive sputum due to the presence of adhesions. Intrapleural pneumolysis done November 22, 1930, by galvanocautery method. A fan-shaped adhesion, ¼ cm. thick and 2 cm. in width, extending from the partially collapsed lung to the fifth intercostal space posterior axillary line, and one cord adhesion, one inch posterior to above adhesion, were severed.

Postoperative course uneventful, temperature never reached 100° F. Within six weeks the daily sputum had decreased from 120 c.c. to 40 c.c. and found negative for tubercle bacilli with the cavity indistinctly seen on x-ray study. Patient abandoned hospital in February, 1931, but continued pneumothorax treatment. In March, 1932, patient was readmitted to Fitzsimons General Hospital with complete pneumothorax, left (Fig. 2). Four days after admission, patient developed lobar pneumonia, right lower lobe, dying within seventy-two hours.

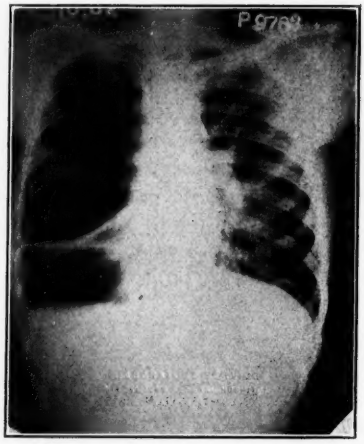

Fig. 2.—Case 1.

CASE 2.—C. B., a soldier, aged forty-two years. Patient diagnosed active pulmonary tuberculosis in April, 1931, and admitted to Fitzsimons General Hospital in September, 1931, with far-advanced pulmonary tuberculosis, having multiple cavitation above the right third rib level and ulcerative tuberculous laryngitis. Artificial pneumothorax, right, induced October 13, 1931. Intrapleural pneumolysis recommended after four months' pneumothorax treatment, as large cavity in upper lobe remained patent due to extensive adhesions above the second intercostal space. Patient operated upon February 18, 1932, by electrosurgical technic; one cord adhesion, 1 cm. in diameter, extending to third rib midaxillary line, was severed. A large band-shaped adhesion extended from second intercostal space in posterior axillary line into apex becoming blended with adherent lung (Fig. 3). The adhesion was coagulated and cut to the point at which it became blended with the adherent lung posteriorly; approximately one inch of the free edge of the adhesion was severed. Fifteen hundred cubic centimeters of fluid had been aspirated twenty-four hours before operation and at operations considerable fluid was present and many small tubercles were seen on the pleural surfaces.

Postoperative course mild, except for chill and fever of 103° F. on the tenth day. Patient gave a history of malaria fever with frequent exacerbations. Quinine was given and above symptoms did not recur. Otherwise, temperature normal after the sixth day. Sputum decreased immediately from 300 c.c. to 100 c.c. in twenty-four hours.

Fluid has reaccumulated and required aspiration three times since operation.

Three months later, x-ray study showed complete collapse, except for an area above the second rib with indistinct cavitation in that area (Fig. 4).

Five and one-half months after operation, patient's temperature is normal, he is semiambulant, has no sputum, and has gained eighteen pounds over preoperative weight.

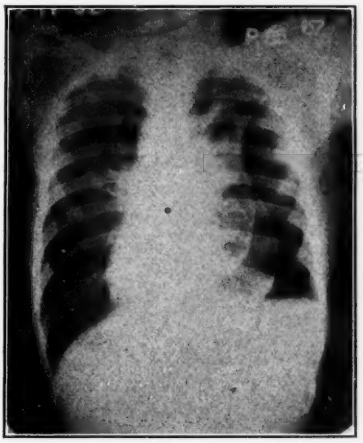

Fig. 3.—Case 2.

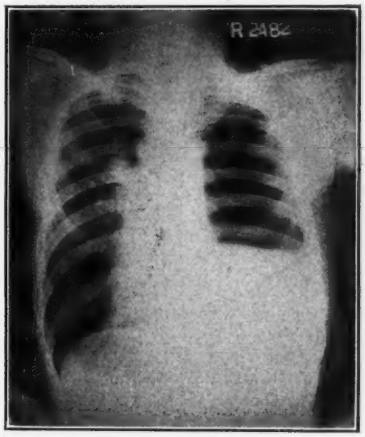

Fig. 4.—Case 2.

CASE 3.—M. W., a soldier, aged forty-one years. Patient diagnosed active pulmonary tuberculosis in April, 1931, and admitted to Fitzsimons General Hospital June 17, 1931, with conglomerate, caseofibrous involvement throughout left lung with small, multiple cavitation in upper lobe and tuberculous laryngitis. Artificial pneumothorax, left, induced July 31, 1931. Intrapleural pneumolysis recommended after three months' pneumothorax treatment to sever adhesions extending into first and second intercostal space, interfering with the collapse of a 4 cm. cavity in upper lobe (Fig. 5). Operation done November 7, 1931, by electrosurgical method with coagulation and cutting of an adhesion attached along first intercostal space and second rib with approximately 3 cm. attachment to chest wall and 2 cm. attachment to the lung. After this adhesion was severed, a cord-shaped adhesion, 1½ cm. in diameter, came into view which was likewise coagulated and cut. It could then be seen that the lung was blended with an adhesion, which extended medially and into the apex, which was unsuitable for cauterization and would probably not interfere with a satisfactory pulmonary collapse.

Postoperative course uneventful; temperature 100° F. the first forty-eight hours, normal thereafter. Moderate pain about operative incision. Sixteen days postoperatively, roentgenograms showed satisfactory pneumothorax with large patent cavity (Fig. 6).

Seven months after operation, cavity is indistinct (Fig. 7), patient has gained twelve pounds in weight, has no sputum, and is doing half-day duty.

CASE 4.—R. C. G., aged twenty-six years, a coal miner for three and one-half years before enlisting in the Army in July, 1924.

Onset of pulmonary symptoms in Panama in August, 1930. Patient admitted to Fitzsimons General Hospital November 1, 1930, with active pulmonary tuberculosis, all lobes both lungs. Nodose type. Left lung showing moderate amount of confluent, nodose, and caseofibrous involvement from apex to fourth rib level with small, indefinite cavitation above second rib level. Patient also had acute gonorrhea at this time.

Six months' bed rest did not bring about satisfactory improvement, as sputum re-

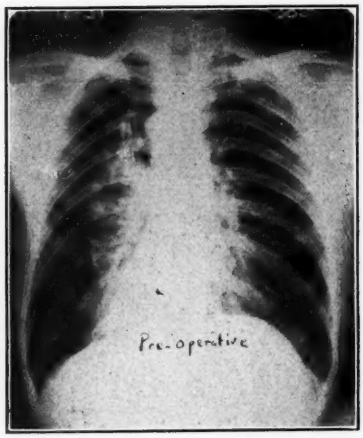

Fig. 5.—Case 3.

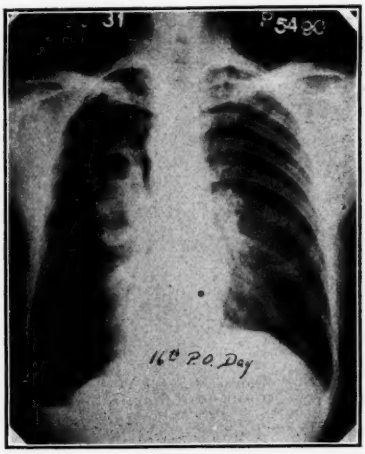

Fig. 6.—Case 3.

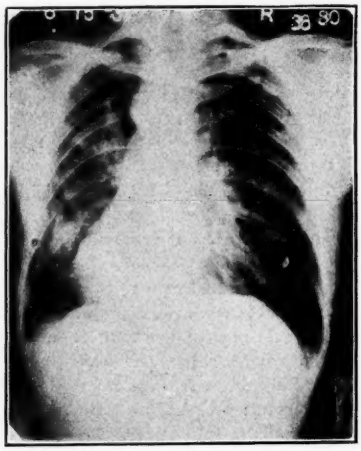

Fig. 7.—Case 3.

mained positive and cavity was increasing in size. Artificial pneumothorax induced on the left in May, 1931. Pulmonary collapse unsatisfactory, due to the presence of adhesions holding open a large cavity in the upper lobe (Fig. 8). Thoracoscopy was decided upon and cauterization by the electrosurgical method was carried out August 11, 1931.

At operation, five adhesions varying in size from small cord to band-shaped adhesions, 3 cm. in width and ½ cm. in thickness, extending from the partially collapsed lung to the second rib level in midaxillary line, were severed. After these were cut, a large band-shaped adhesion extending to the first rib and posteriorly to blend with the adherent lung tissue and chest wall was seen. This adhesion was coagulated at all available points about its parietal pleura attachment. Multiple, small adhesions were

seen in the base of the pneumothorax space which were apparently not of technical importance.

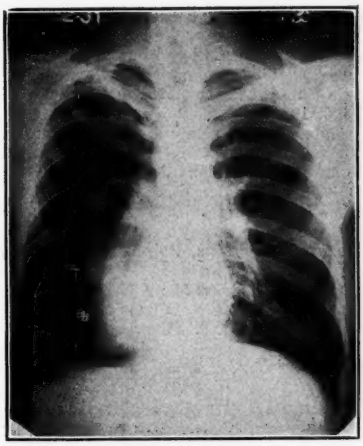

Fig. 8.—Case 4.

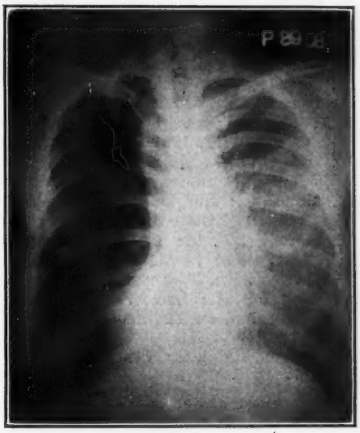

Fig. 9.—Case 4.

Postoperative course mild, highest temperature was 100.4° F., returning to normal within forty-eight hours. Patient lost five pounds during the first three weeks. Sputum has been negative since October, 1931. Positive intrapleural pressure used with production of small amount of fluid which was absorbed. By February, 1932, the cavity indistinctly seen on lateral and apical roentgenograms (Fig. 9). Patient feeling fine with no pulmonary symptoms. It was difficult to keep him restricted and he abandoned the hospital March 15, 1932, and has not been heard from since.

NOTE: The author is grateful to Major W. C. Pollock, Medical Corps, U. S. Army, for his helpful suggestions used in the preparation of this paper.

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BILATERAL EMPYEMA*†

Report of Eight Cases

Carl R. Steinke, M.D., F.A.C.S.
Akron, Ohio

BILATERAL empyema is almost entirely neglected in the textbooks on surgery. If it is mentioned at all, no more than a line or two is given it. Neither *Oxford Medicine*, nor Nelson's *Loose Leaf Surgery*, nor Dean Lewis' *Practice of Surgery* has any mention of it. Tice's *Practice of Medicine* merely remarks that the mortality rate in bilateral empyema is very grave. Bilateral involvement in empyema is infrequent, but its occurrence is not so rare as this neglect would lead one to believe.

In the many excellent papers which have been written in recent years giving reports on long series of empyema cases, bilateral involvement either is not mentioned, or is dealt with only casually in connection with tables showing the side involved.

Farr and Levine,[1] reporting 267 cases of empyema in children, found both sides involved in only 7 instances. Among 161 cases they saw in the last decade, 2 had bilateral involvement, and both died.

Mason[2] reported 1 fatal case of bilateral empyema out of 40 cases of empyema in children. Ochsner and Gage,[3] in a series of 124 cases in adults, found bilateral empyema 5 times.

The best and most recent article on the subject is by Keyes[4] who has thoroughly reviewed the literature and has collected 38 cases from 1910 to the present time. To this number he adds 3 additional cases, 2 in infants and 1 in a boy of seventeen. It is interesting to note that in the 38 cases in which age is known, 23 were in children fifteen years old or younger, and 15 were in adults.

Our studies of empyema do not confirm this ratio. In 102 cases of acute empyema, seen from 1920 to 1932 in the Akron City Hospital only 1 case (0.98 per cent) was bilateral and this in a boy of fourteen years (Case 8). On the other hand, in 229 cases of empyema at the Children's Hospital seen during the same period, bilateral empyema occurred 5 times (2.18 per cent). These cases, together with 2 cases from private practice are reported in this article. From this study it would appear that bilateral empyema in adults is comparatively rare. The great exception to this was in the influenza epidemic of 1918-1919 when many cases of bilateral empyema occurred in children and adults.

Keyes has discussed so thoroughly the subject of bilateral empyema in all of its aspects that this paper can add little to the statistics which he

*From the Akron City and Children's Hospitals.
†Received for publication, May 14, 1932.

has gathered. There are, however, several cases which he has omitted. Ormos[5] reported a case in a child who died when forty-seven hours old, one of the youngest, if not the youngest case of empyema on record. The birth of this child was normal, and the infection was apparently postnatal. Diagnosis was made at necropsy and pneumococci were found in the pus of each side. Dodds[6] quotes the three-day-old patient of Browne who died from bilateral empyema and septic endocarditis. The infecting organism was Bacillus coli. The infection was believed to be antenatal because there had been an early rupture of the membranes. Dodds also reports a case of his own of a cyanosed child delivered with the umbilical cord twisted four times around its neck. Death occurred at the age of eighty-

Fig. 1.

Fig. 2.

Fig. 1.—Case 1, showing tubes inserted between the ribs.
Fig. 2.—Case 1, at fifteen years of age.

seven hours. Autopsy revealed double pneumonia and a large amount of pus in both pleural cavities. Cultures showed both staphylococcus and pneumococcus.

Mason[2] reports an eighteen-month-old patient with bilateral empyema complicated by otitis media. Rib resection was done on the right and aspiration on the left side. Death followed from respiratory complications. In discussion of this paper Alexius McGlannan reported bilateral empyema and suppurative pericarditis in a child who recovered following aspiration and operation on each cavity.

These 5 cases, together with the 8 reported in this paper bring the number of cases of bilateral empyema to 54. This does not include the 10 cases in children and 5 in adults mentioned casually in long series of statistics,

and in which no details are given. Including these 15, the total number is 69 cases of bilateral empyema in the literature since 1910.

CASE 1.—R. W., aged three years, white male, had lobar pneumonia starting December 15, 1914. On December 30, left side was tapped and about 4 ounces of greenish-yellow fluid was obtained. On January 19, 1915, when the right side was tapped, 3 ounces of pus were aspirated, and a tube was put in. January 21, a left thoracotomy was performed with tube in eighth interspace, and 1 pint of gray-greenish pus was evacuated. March 2, the right side which had healed over was reopened and 1½ ounces of pus and bloody serum were drained out. By April 12 the temperature was normal, the chest findings were greatly improved, and the child made a good recovery. Five years later the boy had grown normally and is now in good health. Figs. 1 and 2.

CASE 2.—J. B., aged fourteen months, white female, admitted April 26, 1929. Illness began two weeks before with high fever and symptoms of a "cold." Ears were lanced the second day but drained very small amount since that time. Considerable trouble in breathing since onset of illness. Symptoms became progressively worse. On admission 50 c.c. of pus were aspirated from the left chest. Roentgenogram, April 26, showed the heart slightly displaced to right and fluid in left side of chest. April 27, subperiosteal resection of a portion of the eighth rib was done and a drainage tube was inserted. In a culture of pus, pneumococcus was found. There was a moderate amount

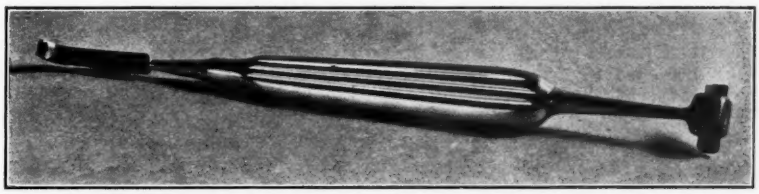

Fig. 3.—Small sized Alexander rib periosteal elevator for use in small children and infants.

of drainage but throughout the day her condition remained unfavorable, with continued drainage from the left ear. Roentgenogram showed increased density in right chest. After aspiration of 15 c.c. of thick pus, rib resection was done on the right and a drainage tube was inserted; Brewer tube was placed in the left chest. There was considerable drainage from both pleural cavities, but more from the left. Patient continued to have a septic temperature, with drainage from both chest and ears; she gradually became weaker and died on May 20. Autopsy diagnosis: Slight pericardial effusion; bilateral empyema; bilateral bronchopneumonia; subacute glomerular nephritis.

CASE 3.—R. B., aged six years, white male, admitted May 4, 1928. Twelve days previous to admission the patient developed pneumonia. Roentgenogram showed fluid signs in left thorax and heart displaced to right. Temperature had been septic in type. May 4, left air-tight drainage following resection of seventh rib in posterior-axillary line. On May 13, 350 c.c. of thick yellowish pus were aspirated from the right chest. From this time on the patient's condition grew worse, respirations were labored, temperature 104° to 105° F., and patient died May 14. Autopsy could not be obtained. Culture of pus revealed pneumococci.

CASE 4.—W. Mc., aged four years, white male, admitted September 6, 1929. Patient had swallowed a metal eyelet on previous day. Awoke at 2:00 A.M. and said his throat hurt him. Difference in breathing noticed at 10:30 A.M. Admitted in rather marked asphyxia and tracheotomy was done immediately, relieving the condition. Roentgenogram was taken same day without finding evidence of foreign body. September 8, tem-

perature was elevated with pulse very rapid and weak. Heart markedly enlarged and there was an area of beginning pneumonia at the left base. *Impression:* Streptococcic septicemia with bronchopneumonia and myocarditis. September 9, following transfusion of 200 c.c. of blood, patient reacted well. Heart was much smaller and patient's condition improved. September 11, condition improved after transfusion of 200 c.c. of blood but pulse again became rapid and weak. Autopsy: Laryngotomy. Long thin blood clot in trachea; no foreign body found in tracheobronchial tree. Bilateral bronchopneumonia and bilateral empyema were found. Cultures: probably B. influenza.

CASE 5.—M. M., aged six weeks, white female, admitted November 9, 1929, with large hydrocephalus, large lumbar spina bifida and bilateral club feet. Lungs normal. Child gained weight (probably due to increasing hydrocephalus) and ran a favorable course until the fourth day when she had difficulty in breathing, and the patient died. Autopsy: Acute bilateral empyema. Extensive bilateral purulent bronchopneumonia. Marked internal hydrocephalus with compression of cerebellum and spinal leptomeningitis. Complete spina bifida with myelomeningocele. Bilateral pes equino varus.

CASE 6.—H. K., aged eighteen months, white male, admitted December 17, 1929. Five days previously he developed pneumonia and later his condition became worse with pain in the left chest. Loose cough, and some dyspnea but no cyanosis. There was extreme distention of the abdomen. Dullness throughout left side with bubbling râles. Heart pushed to right; sounds somewhat weak but regular. In the skin a diffuse anasarca was present, most pronounced about eyelids. Roentgenogram on admission showed evidence of fluid in left chest with heart displaced to right. There was interlobar pleural thickening between right upper and middle lobes. One hundred and fifty cubic centimeters of thick greenish fluid were aspirated from the left chest and 20 c.c. on the following day. Culture revealed pneumococcus. December 21, air-tight drainage in seventh intercostal space of midaxillary line. Thoracic cavity was found almost completely filled with thin cloudy serum (of which only 5 or 6 ounces were withdrawn). Patient died nine hours later. Autopsy: Bilateral empyema, bilateral bronchopneumonia, and purulent pericarditis.

CASE 7.—G. G., white female, aged six years, admitted August 1, 1931. At 3:30 A.M. on previous day the child began to complain of pain in abdomen and later to vomit. There was no history of previous attacks; but there was a history of vaginal discharge which had just recently cleared up, although some had appeared again that morning. Patient was a fairly well-nourished, acutely ill white female, holding her legs flexed at knees and thighs flexed at hips and appearing to be in acute pain; respirations were entirely thoracic in type. Chest and heart were normal. The entire abdomen was markedly rigid and tense and especially tender on the left. Rectum was not tender to finger palpation but the uterus and culdesac, especially on the right, were. There was a small amount of purulent discharge from the vagina. Roentgenogram August 4, showed increased density of both sides, especially the left, and calcifications and adenitis in hila. Interlobar pleurisy was found between right middle and upper lobes. There was parenchymatous infiltration of the left lower posterior to the second and third interspaces anteriorly. Temperature was 103.6° F., pulse 150, respiration 30. Two hours after admission an appendectomy was performed, with drainage of the pelvis. Pneumococci were found on culture. Both pre- and postoperative diagnoses were pneumococci peritonitis. Abdomen contained 3 or 4 ounces of rather thin grayish pus which was most extensive in the pelvis, particularly in the neighborhood of the tubes which were covered with patches of thick fibrinous exudate. On August 4, she was given a blood transfusion. Examination of the lungs on August 5 showed bilateral pneumonia. Condition grew worse and patient died at 7:35 A.M. August 6. Autopsy: Bilateral empyema; bilateral bronchopneumonia; diffuse purulent peri-

tonitis; acute mesenteric and retroperitoneal lymphadenitis; subacute nephritis; acute bilateral salpingitis.

CASE 8.—G. A., aged fourteen years, white male, admitted August 27, 1927. Patient had a tooth pulled August 2, 1927; a cough started four days later, followed by expectoration ten days afterward. There was a moderate amount of hemoptysis. Dullness was located up to the fourth interspace on the left front and around to back on the same level, with bronchial breathing anteriorly above the dullness. Roentgenogram, August 29, showed thickened pleura on the left side with a density level at the fourth interspace posteriorly. The heart was greatly displaced to the right. The same day the left ninth rib was resected in posterioraxillary line and considerable pus was obtained. The lung was adherent, walling off the anterior portion of the cavity. Rubber tube drainage was fixed into the cavity. Culture revealed pneumococcus. Roentgenogram on September 14 showed thickened pleura on the left and absence of the fluid level as seen on the previous film. The right thoracic cavity showed interlobar pleural thickening with some fluid present. The right thoracic cavity was aspirated September 16, with removal of 30 c.c. of red-tinged pus. Culture showed pneumococcus. On September 19 the parents removed the child from the hospital, but follow-up revealed that the boy made a good recovery.

SUMMARY

1. Report is made of 8 cases of bilateral empyema in children from six weeks to fourteen years of age from a total of 332 cases of acute empyema (230 children, 102 adults) observed from 1920 to 1931, inclusive.

2. Four of the 8 cases occurred at the Children's Hospital in 1929, and none from 1920 to 1927. The greater number of necropsies obtained may be responsible for an increasing number of bilateral empyema diagnoses.

3. In 6 of the 8 cases, empyema followed a recognized pneumonia. In one remaining case pneumonia was found at autopsy (Case 5) and in Case 8, the condition followed the pulling of a tooth. Pneumococci were found in 5 of the 6 cases in which cultures were made. In the sixth case Bacillus influenza was found.

4. Diagnosis of bilateral empyema was made before death in 4 cases and was not made in 4 cases.

5. Bilateral drainage was performed in 2 cases, and unilateral drainage in 3 cases. Neither empyema was drained in 3 cases; all of them were undiagnosed before death and the empyemas found at autopsy.

6. Six (75 per cent) of the 8 patients died. The high mortality in this and other series of cases is due to the severity of the primary or causative disease, usually bilateral pneumonia, or to its complications, and not to the type of treatment used. The 2 patients who recovered were treated by bilateral open drainage, and drainage of one side and aspiration of the other side, respectively.

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THE INSEPARABILITY OF ENDOSCOPY AND THORACIC SURGERY*

W. A. HUDSON, M.D.
DETROIT, MICH.

IN THE 1925 edition of his book on Thoracic Surgery Lilienthal states that "Peroral endoscopy is one of the greatest aids to thoracic surgery. It should not be omitted whenever there is the slightest chance that it may add knowledge which we could not otherwise acquire, and these occasions are more numerous than might at first sight be suspected." Continuing his discussion he goes on to state, "So in the endoscopic work within the thorax we shall see an ever-widening field of usefulness as the instruments improve and the man who handles them grows in skill and resourcefulness. Already we are dealing with a true specialty in which only those who have become proficient are capable of properly interpreting the images before them and of manipulating to the best advantage the apparatus at their command. This does not mean, however, that the thoracic surgeon himself may not become expert as an endoscopist, but that the practice requires a natural aptitude in order to excel. He who would do thoracic surgery must have either a working knowledge of endoscopy or he must understand its possibilities and its limitations so that he may grasp at second hand the interpretation of what is seen by the specialist in the depth of the esophagus or bronchi." We should not be surprised to find, in going over the list of the forefathers of thoracic surgeons, that a majority of these were not endoscopists. We should note, however, that the value of their contributions to the development of thoracic surgery depended in a very large measure upon their broadmindedness and their resourcefulness in the use of other specialties including especially endoscopy. It is a noteworthy fact that there has been associated with those centers where early worthwhile advance in thoracic surgery has been made, an endoscopist with some degree of skill. To illustrate the point, we need only to mention the work of those men associated with Chevalier Jackson, Vincent, Archibald, Lilienthal, and Sauerbruch.

Although the early development of endoscopy was centered around removal of foreign bodies from the air and food passage, one who would do endoscopy to the best advantage must not depend upon the occasional opportunity to remove a foreign body for his experience. In fact we have come to feel that there is no practitioner so admirably situated to acquire extensive experience in endoscopy as the thoracic surgeon. He above all others is the one who has at his command an abundance of material in the

*Read at the Fifteenth Annual Meeting of the American Association for Thoracic Surgery at Ann Arbor, Michigan, April 18, 19, 20, 1932.

study and disposal of which endoscopy can and does offer the greatest opportunity for diagnostic and therapeutic aid.

As early as 1922 we reached the conclusion that we must do our own endoscopy if we would obtain the greatest amount of benefit from such studies. The average nose and throat man who does endoscopy has no great interest in the study of intrathoracic disease and it becomes a real burden for him to interrupt his active nose and throat practice to carry out an endoscopic examination on a charity patient for the thoracic surgeon. By setting aside certain regular hours on certain days of each week for endoscopy the thoracic surgeon is surprised to find that there is an ever increasing volume of material brought to his clinic for endoscopy. The surprising thing about the development of such clinics is the fact that a considerable proportion of the material sent to the clinic comes from nose and throat men, many of whom were previously supposed to do endoscopy. It is also noteworthy that in those general hospitals where thoracic surgeons or endoscopists have endeavored to make use of the available material that there has always been an abundance of material for the work. Our own experiences serve to illustrate the point; whereas, before the establishment of such clinics for endoscopy there was an occasional endoscopic examination performed at the hospitals which we are attending, we find today that in the same institutions there are performed as many as three hundred endoscopic examinations a month. The variety of conditions in which endoscopy can be of aid either from a diagnostic or therapeutic standpoint is unlimited and we are not in a position as yet to set up definite limitations because each day brings to our attention some new problem in diagnosis or therapeusis in which endoscopy can play a part. Chevalier Jackson has set down contraindications to bronchoscopy at different times, "Subject," as he stated, "to future revision."

It is only proper that we review some of the material that has passed through our hands as thoracic surgeons in which endoscopy has proved to be an aid either in diagnosis, therapeusis, or in both.

During the last decade there has appeared an increasing volume of literature dealing with the treatment of suppurative lesions of the lung. The observations of the Chevalier Jackson Clinics are among the most outstanding and illustrate the benefit that can be obtained from endoscopy. In our earlier experiences we encountered a considerable proportion of cases in which some form of open drainage or collapse therapy was resorted to, but as our experience has increased we find that fewer cases are requiring open drainage or other radical forms of surgery. We account for this change in three ways: first, we are instituting endoscopic drainage at the earliest moment possible, once a suppurative lesion or its precursor is discovered; second, endoscopic drainages are performed more frequently and extended over a longer period of time, so that we not only provide a drainage canal but the canal is kept open until the last vistage of inflammation has disappeared; third, many cases of a character that was not considered suit-

able for endoscopic treatments and were therefore hurried through some form of open surgical drainage, are now being submitted to endoscopic treatment with success.

POSTOPERATIVE MASSIVE ATELECTASIS

Since we observed our first case of postoperative massive atelectasis with Scrimger in 1923, we have felt that conservative measures should be used in the treatment of these conditions and we have advocated the encouragement of the patient to breathe deeply, the moving of the patient from side to side, and the administration of carbon dioxide and oxygen mixtures as means of relieving the respiratory distress; but we are firmly convinced that these measures must not be relied upon to the exclusion of endoscopy. Repeatedly we see patients in whom the endoscopic removal of a fibrinous plug or an accumulation of secretion gives almost immediate relief; whereas the most conservative methods might have given relief in time, the distress of the patient was of such severity that we felt more than justified in interfering. There have been certain cases which were not recognized until it was hardly probable that the patient would have made a complete recovery without a residual suppurative lesion.

We would not limit our discussion of atelectasis to the massive type. There have been encountered a number of instances of lobular atelectasis following griplike infections and others following whooping cough which had failed to clear up until endoscopy was resorted to. In such cases we have found an inflammatory obstruction in a secondary bronchus. These involved secondary bronchi are identified by the fact that their orifices are invariably red and the mucosa is pouched to a varying degree.

The early diagnosis of a malignancy in any portion of the body presents certain difficulties, but the very early diagnosis of a malignancy in the bronchial tree is particularly difficult. It is a noteworthy fact that there is an ever increasing number of cases of cancer of the lung being reported. Some believe that this is due to an actual increase in the frequency of malignancy of the lung, but we are convinced that the increase in the number of cases seen in our own clinics is due to the fact, first, that we are looking for malignancy of the lung, and second, that we are learning to recognize the lesions earlier.

The free use of roentgen ray studies is of a very great help in the diagnosis of malignancy of the bronchial tree, but in most instances in which the diagnosis is based upon roentgen ray findings, the lesion is too far-advanced for the thoracic surgeon to accomplish a great deal. There is only one way for us to make a positive and very early diagnosis; that is, by resorting to endoscopy at the appearance of the earliest symptoms. The appearance of an unexplained cough or blood-spitting should lead at once to a roentgen ray study of the chest; but "An apparently negative roentgen ray study should not, however, interfere with the carrying out of an endoscopic examination in a patient whose symptoms suggest some pulmonary

lesion.'' The strict adherence to such principles will lead to the early diagnosis of more and more bronchiogenic carcinomas and to an ever increasing number of reports of cures and apparent cures.

ESOPHAGEAL CANCER

Cancer of the esophagus has long been recognized as a slowly developing disease which has a death rate of practically 100 per cent. This certain mortality is dependent to a large extent upon the fact that the positive diagnosis is made early only in the rarest of instances. It is our hope that we may be permitted to make a diagnosis while the lesion is still confined to its initial site and before any ulcerations have occurred.

We see very little hope of duplicating the remarkable case of Dr. Torek unless we are ever alert to the possibilities of diagnosing such lesions by means of endoscopy, even before the roentgen ray gives us an indication of the condition.

DISCUSSION

DR. FREDERICK T. LORD (BOSTON).—With us, bronchoscopic treatment has proved disappointing in patients with bronchiectasis or abscess of other than foreign body origin. Postoperative atelectasis arising in consequence of bronchostenosis from tenacious secretion is likely to be transient and bronchoscopy has not thus far seemed necessary.

DR. WILLIAM A. HUDSON (DETROIT).—I would only state, as I stated in the paper, that we are heartily in favor of the application of conservative methods in the treatment of massive atelectasis, but in our own experience we have encountered some particular cases in which, because of the patients' grave condition, we have felt justified in being more radical. I think the examples of pulmonary abscess will speak for themselves.

CONSTANT POSITIVE PRESSURE NITROUS OXIDE OXYGEN ANESTHESIA FOR THORACIC SURGERY*

ALBERT H. MILLER, M.D.
PROVIDENCE, RHODE ISLAND

RESPIRATION proceeds under the normal atmospheric pressure of 14.5 pounds to the square inch, represented by a column of mercury 760 mm. high or a water column of 408 inches. One mm. equals 0.04 inch, and, as mercury is 13.5 times as heavy as water, the pressure measured by 1 mm. of mercury is equal to the pressure of 0.58 inch of water and 1 inch water pressure equals 1.9 mm. mercury pressure. It is convenient to remember that the pressure of 1 inch of water is nearly equivalent to that of 2 mm. of mercury.

Atmospheric pressure, equivalent to 408 inches water pressure, constantly affects the exterior surface of the chest. Through the trachea and bronchial tubes, the pulmonary air sacs communicate freely with the external atmosphere except for the narrowing of the air passage at the glottis. As a result of this narrowing, the intrapulmonary pressure increases by 4.6 inches water pressure during expiration and diminishes to –5.8 inches during inspiration. In the intervals between inspiration and expiration, the intrapulmonary pressure returns to the normal atmospheric pressure. If the respiratory passages are obstructed, the changes in intrapulmonary pressure are accentuated. During inspiration the pressure may become –46 inches water pressure and during expiration, may increase to 58 inches. These changes in intrapulmonary pressure directly affect the pleural sacs and the mediastinal organs including the heart and great blood vessels. They must be seriously considered in planning for increased intrapulmonary pressure during thoracic operations. An increase of 58 inches water pressure is said to be sufficient to prevent the flow of blood into the right auricle.

The framework of the lungs consists almost entirely of elastic fibers which unite to form a network completely surrounding each air sac and constituting the partition between them. In the newborn child this elastic tissue is contracted during expiration and is only slightly stretched by inspiration. Expiration as well as inspiration is an active muscular movement. As the chest increases in size with the growth of the child, the lung becomes more and more distended and the elastic framework is put more and more on the stretch. Inspiration continues as an active movement but expiration becomes passive, depending upon the elastic recoil of the pulmonary framework and the elasticity of the

*Received for publication, January 29, 1932.

costal cartilages. The pressure exerted by the elasticity of the lungs has been measured by tying a manometer into the trachea of a cadaver and observing the rise of pressure which takes place on puncturing the chest wall. The pressure registers 5 to 7 mm. of mercury. If the lungs are first distended to a degree corresponding with deep inspiration, the pressure increases to 30 mm. of mercury. The elastic pull of the lung upon the pleural sacs and the mediastinum, varies, therefore, with the condition of respiration, being least at the end of expiration and greatest at the end of forcible inspiration when the lung is most distended. At the end of quiet expiration, the elastic pull is –2.6 inches water pressure; at the end of inspiration it is –4.38 inches water pressure and at the end of forcible inspiration it may become –17.4 inches.

When an opening is made in one side of the chest, the elastic tissue of the lung contracts and the lung immediately collapses. The elastic pull of the sound lung is exerted on the mediastinum, which moves toward the sound side compressing this lung. Marked dyspnea immediately develops. To draw air into the sound lung, pronounced muscular effort is required and this is largely ineffectual because of the lateral excursion of the mediastinum. The muscular exertion, displacement of the mediastinal organs and interference with oxygen supply soon bring on signs of shock. The circulation is affected, the pulse becomes rapid and feeble and the color cyanotic. Rupture of the diaphragm has much the same effect. Drawn by the elastic pull of the lungs, the abdominal viscera enter the chest, the lung on the affected side collapses and the mediastinum is drawn toward the sound side compressing the sound lung.

Hernia of the diaphragm, as seen clinically, follows traumatism but is usually a false hernia and of congenital origin. In the congenital type, the left side is the one generally affected. The viscera found in the chest as the result of the hernia may include the stomach, the spleen, and the large and small intestines. The symptoms vary from cough, dyspnea and mild indigestion to the pain, vomiting and distention of acute intestinal obstruction. The signs are often indefinite and an accurate diagnosis is made only with the aid of the x-ray examination. The operation for diaphragmatic hernia is a serious one with a mortality rate of 23.4 to 53.1 per cent.[1]

Anesthesia for thoracic surgery has been carried out with the aid of differential pressure cabinets, by intratracheal insufflation of ether vapor and air, and by nitrous oxide oxygen, utilizing a rapid flow of the gas to maintain increased intrapulmonary pressure. Paul Bert was the pioneer in the use of differential pressure. His positive pressure cabinet was too complicated, bulky and costly for general use, but with it he proved that nitrous oxide under pressure gains so much in efficiency that anesthesia may be maintained with a larger proportion of oxygen than under normal conditions. In the cabinet devised by Sauerbruch, the outside of the chest was affected by negative pressure maintained by

an electric air pump while the patient's head, outside the cabinet, was subject to atmospheric pressure.

In the intratracheal method, after the patient has been deeply etherized, a No. 24 French, woven silk catheter is passed through the glottis and nearly to the bifurcation of the trachea. By means of an electric pump a current of air is forced through the catheter and escapes around it. Anesthesia is maintained by addition of ether to the insufflated air. Increase in intrapulmonary pressure is controlled by the rate of flow of the air current. Dangerous complications occur if the catheter enters the esophagus or one of the bronchi or if respiration ceases as the rapid flow of air washes out the carbon dioxide and causes acapnia. The advantage of the intratracheal method appears if the patient vomits, when vomited material is prevented from entering the lungs by the outcoming current of air around the catheter.

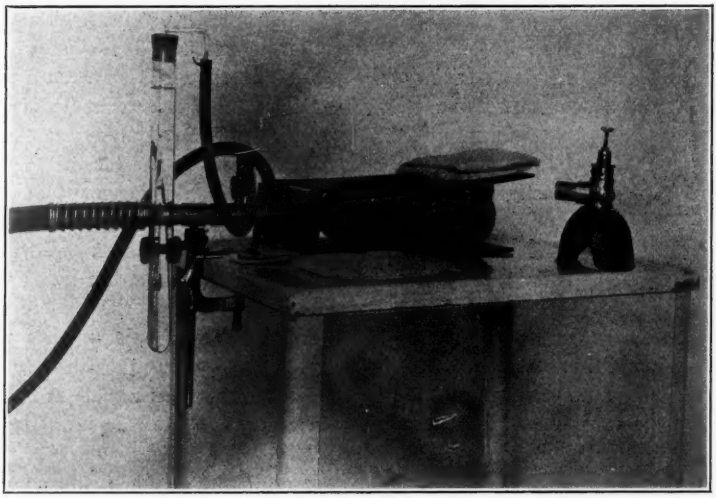

Fig. 1.—The breathing bag with pressure controlled by bags of shot and indicated on a water manometer. The upper leaf of the fiber casing is hinged at one end. The inlet from the gas oxygen machine and the breathing tube are on the left, and the inhaler with expiratory valve controlled by a spring is shown detached on the right.

For positive pressure by a rapid flow of nitrous oxide oxygen, the apparatus must deliver at least five gallons of gas per minute in order to maintain pressure during inspiration. During expiration, the entire flow of gas as well as the amount expired, must escape through the expiratory valve. This valve is controlled by the tension of an adjustable spring which is set to blow off at the pressure required. Beside the element of waste, this method is likely to provide either a great increase of pressure during expiration or insufficient pressure during inspiration.

In devising a method of anesthesia for thoracic operations under in-

creased intrapulmonary pressure, we have chosen nitrous oxide oxygen because this mixture does not irritate the pulmonary mucous membrane, is neither inflammable nor explosive, and because the efficiency of the nitrous oxide is so increased under positive pressure that anesthesia may be maintained with an abundant supply of oxygen. The increase in pressure need not be large. Four and one-half inches water pressure, about 1/100 of an atmosphere, is sufficient to overcome the elastic pull of the lungs under ordinary conditions of respiration, but this pressure must be constant and efficient during inspiration as well as during expiration. To maintain positive intrapulmonary pressure we have used a stout rubber bag compressed by the weight of bags of shot to any de-

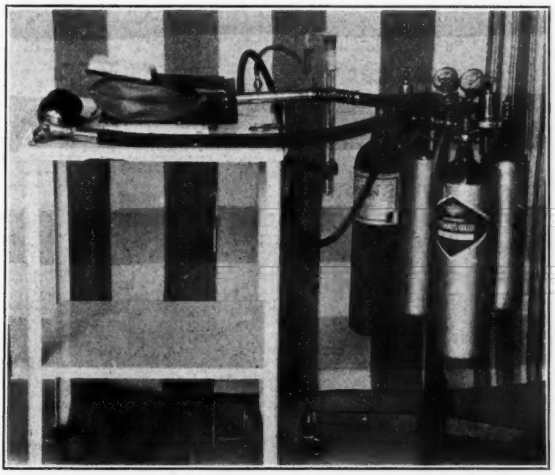

Fig. 2.—The breathing bag connected with a gas oxygen machine and ready for use. Pressure control is more exact with the bag in the horizontal rather than in the vertical position.

sired pressure. Into this bag the patient breathes to and fro against a positive pressure determined by the weight of the shot bags and indicated on a water gage attached to the apparatus. The water gage is preferable to a mercurial manometer because it is more easily read.

A steady flow of nitrous oxide and oxygen in the correct proportions to maintain anesthesia is supplied to the bag by an accurate gas oxygen machine of the constant flow type. The usual rate of flow is two gallons per minute. On the rate of flow depends the amount of rebreathing to which the patient is subject. The first part of each expiration returns to the bag to be rebreathed, but the last part, coming from the deeper parts of the lung, wastes through the expiratory valve according to McKesson's principle of fractional rebreathing. The more rapid the flow of gas, the less the amount of rebreathing.

The inhaler is provided with a stiff rubber face piece which is accurately fitted to the patient's face. To aid in holding the inhaler in place, the face piece is strapped to one cheek with adhesive plaster. The expiratory valve, located on the inhaler, is controlled by an adjustable spring set to blow off during expiration but to remain closed during inspiration. This spring must be adjusted to compensate for changes in pressure determined by the weight of the bags of shot.

The operation for diaphragmatic hernia employed by Dr. P. E. Truesdale[2] comprises a suitable opening in the chest wall, reduction of the abdominal viscera after freeing what adhesions may be present, repair of the hernial opening, expansion of the lung and suture of the chest wall. The patient is placed on the sound side, usually the right, with the knees drawn up as if sitting, in a specially devised seat attached to the operating table, and is anesthetized in this position. The arm of the affected side is drawn up above the head and is held in this position by a rope and sling controlled by a pulley. When the operation is about to be commenced, the head of the table is raised 45 degrees or more. Before the chest is opened, intrapulmonary pressure is increased by two inches water pressure and is maintained at this point until expansion of the lung is required. With the chest wall open, the patient breathes well under this pressure. If the pressure is allowed to fall, respiration becomes labored and may cease altogether, but quickly returns if the pressure of two inches is restored with a temporary increase in the oxygen percentage.

At two inches' pressure, the lung is contracted to about half its capacity and does not interfere with the performance of the operation. The effect of this small increase in intrapulmonary pressure is exerted principally in preventing displacement of the mediastinum and compression of the sound lung. When the fault in the diaphragm has been repaired and it is time to close the chest wall, the lung is inflated by increasing the intrapulmonary pressure. Six inches' water pressure is generally enough to bring the lung in contact with the chest wall and eight inches to cause it to bulge through the opening. The oscillation in pressure due to respiratory movement, as indicated on the water gage, does not exceed one inch in either direction. This oscillation of two inches is evident as the lung expands under six inches' pressure. The lung approaches nearer the chest wall during expiration but expands at a slower rate during inspiration. This step by step expansion of the lung is due to the change in intrathoracic pressure resulting from the narrowing of the air passage at the glottis.

The patients show the effect of the operation by some symptoms of shock. The pulse is weak, the skin is cold and moist, and the blood pressure is lowered. This condition is largely postural and corrects itself as soon as the head of the table has been lowered at the close of the operation. None of the patients has required stimulation. The increased

efficiency of nitrous oxide due to positive pressure is notable. In some cases satisfactory anesthesia has been maintained with nearly 50 per cent oxygen in the mixture.

For simpler thoracic operations, this form of anesthesia is almost ideal. Without positive intrapulmonary pressure, general anesthesia for these cases has often been a nightmare for the anesthetist. With the patient lying on the sound side and respiration in the sound lung hindered by his own weight, on opening the affected side of the chest, the patient is likely to be thrown into desperate condition if depressed by more than the slightest possible degree of anesthesia. Because of unfavorable results from general anesthesia, regional anesthesia has come to be employed generally for these cases but has often resulted in harrowing experiences, especially with children. Without prejudice to the benefit of regional anesthesia in many conditions, in a thoracotomy under regional anesthesia, the dyspnea, the sound of cracking ribs, and the hissing of air drawn in and out through the thoracic wound as the patient struggles for breath are all distressing even if free from pain. Under constant intrapulmonary pressure, the patient may safely be placed on the sound side, and the operation can be done with little attention to the effect on respiration.

CONCLUSIONS

Constant intrapulmonary pressure maintained during inspiration as well as expiration is a valuable aid to the performance of operations requiring thoracotomy. For anesthesia, nitrous oxide oxygen is advantageous because it is not irritating to the respiratory mucous membrane and is readily subject to pressure control. This method is specially useful in operations for diaphragmatic hernia.

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THE SILVER CLIP METHOD OF PREVENTING HEMORRHAGE WHILE SEVERING INTERPLEURAL ADHESIONS*

With a Note on Transillumination

Norman Bethune, M.D., F.R.C.S.(E.)
Montreal, Canada

THE use of the galvanic cautery in the Jacobaeus operation, although simple and in most cases safe, carries with it the possibility of encountering, sooner or later, an uncontrollable hemorrhage. Jacobaeus has reported such a fatal case. Some operators in this country have had harrowing experiences with hemorrhage. Matson, Alexander, and O'Brien have had nonfatal hemorrhages occur with a loss of from one thousand to two thousand cubic centimeters of blood. I myself have seen a hemorrhage of five hundred cubic centimeters, while cutting with the galvanic cautery, an unsuspicious cord-like adhesion. Although it is stated that the bleeding occurs from the distal (that is, the costal) cut end of the adhesion, in my case, the bleeding came from the visceral stump. To see the stump of a cut adhesion throwing out a little jet of arterial blood with every beat of the heart, to see that blood pooling up in the pleural space, and to feel one's comparative impotence to deal with such a possibly fatal event through a small intercostal cannula, at a distance of ten inches and with only a galvanic cautery at hand, is by no means a pleasant experience. It was finally controlled by the cautery, although I was in two minds whether or not to do an immediate open operation and apply forceps. Flooding of the pleural cavity with hot saline has been advocated, but its action would seem to be very uncertain. Pleural hemostats have been devised but at some time or another they have to be taken off and the application of ligatures without open operation is technically impossible.

There is no doubt that the best way to prevent hemorrhage is by preliminary electrocoagulation and then cutting with a high frequency current. This, however, necessitates special electrodes, such as devised by Maurer of Davos and Matson of Portland, and an expensive, sensitive, high-frequency machine, such as the Bovey unit. This is beyond the means of any but the best equipped clinics. The only safe way to use the galvanic cautery is to avoid the commonly advocated cherry-red glow with its speed and smoke, and reduce the current down to the "cold" tip. This "cold" current is about three volts on the rheostat and will slowly char a piece of dry gauze. The tip is not visibly hot. Using this, no smoke obstructs the view, and a wide zone of blanching is produced before the adhesion separates slowly. The disadvantage is the longer time taken to cut the adhe-

*From the Medico-Surgical Pulmonary Clinic, Royal Victoria Hospital, Montreal.
Received for publication, August 1, 1932.

sion. Wells, of Saranac Lake, and afterwards Fisher, of Waverly Hills, Kentucky, first brought my attention to this "cold" cautery. Since using it in my past forty cauterizations, no hemorrhage has occurred.

It would seem that the problem of controlling hemorrhage without the use of electrocoagulation is reduced to foreseeing, if possible, the presence of blood vessels or lung in adhesions and secondly, to prevent bleeding before the adhesion has been severed. In 1930, after having had a large nonfatal hemorrhage while using the cherry-red galvanic cautery, I began experimenting with silver clips, scissors, and the transilluminator. Using the thoracoscope, one has to rely on surface visualization and make up one's mind as to the potential content of lung or blood vessels of the larger adhesions. The rounder, broader, and the more conical the adhesion, particularly if the base of the cone is on the visceral side, the greater the chances

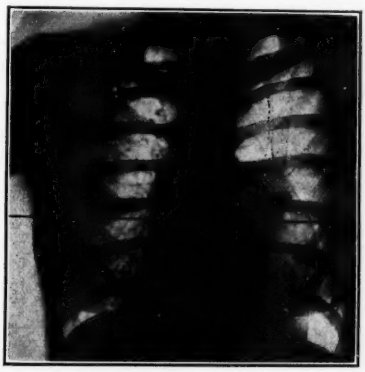

Fig. 1.

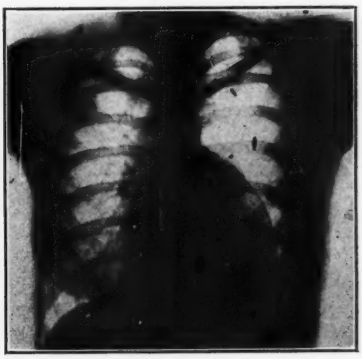

Fig. 2.

Fig. 1.—Left pneumothorax with adhesions. (Retouched.)
Fig. 2.—Eight months after application of four silver clips and cutting with scissors through intercostal cannula. Phrenicectomy. No fluid. Left diaphragm up. (Not retouched.)

of its being dangerous. Some membranous and many thin fibrinous strings, cords, bands, and shelves are actually transparent, but the more fibrous, thicker, and shorter the adhesion the more uncertainty pertains as to its contents. Transillumination here will be of great assistance. Archibald has been using for years a curved Cameron light in the pleural space during open operation. I was struck with the fact that in many adhesions it is possible to see through them and to determine whether or not they contain lung or blood vessels. Of course, very thick adhesions with their indurated pleural sleeve cannot be transilluminated. A small, oval intercostal cannula and an illuminated probe, with its lamp at an angle of forty-five degrees, were first made. This gave an excellent view during the Jacobaeus operation if the light of the thoracoscope is turned off. The intercostal cannula was made to accommodate clip-applicator forceps and scissors. Small silver clips were made to apply to the adhe-

sion like putting clothespins on a clothesline. They have an angle of ninety degrees, each limb being one centimeter long, two millimeters wide and one-half millimeter thick. Two sharp, short prongs to prevent slipping are on each limb. The clip is placed in the jaws of the clip applicator, the blades of which are ten inches long and have a universal grip handle. When the handle is squeezed, the jaws of the clip-holder close the clip tightly and at the same time release it. The clips are put on under the direct view of the thoracoscope. They are applied a quarter of an inch apart, and the adhesion is cut through between them with the scissors, whose long handles (ten inches) and short blades (one centimeter) give a powerful action. The distal clip hugs the chest wall. Instead of the scissors, the galvanic current can be used to sever the adhesions between the clips; however, the scissors give a clean, sharp cut

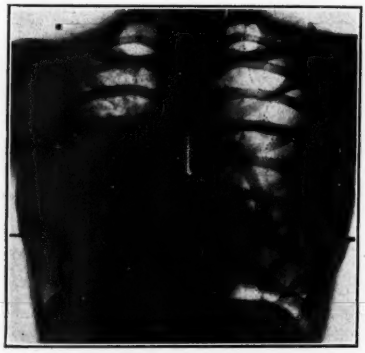

Fig. 3.

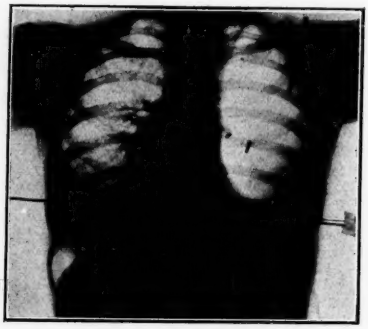

Fig. 4.

Fig. 3.—Left pneumothorax with multiple adhesions. (Retouched.)
Fig. 4.—Six months after application of seven silver clips and cutting adhesions with scissors through intercostal cannula. Phrenicectomy. No fluid. Left diaphragm up. (Not retouched.)

and there is no burnt tissue to be absorbed or slough off. In addition, the reaction of the pleura to the heat of the cautery is avoided. It is very reassuring to see the blanching and avascularization produced about the firmly closed clips.

For the ordinary Jacobaeus-Unverricht instrument, I have had made for use through its small flexible cautery cannula, a smaller transilluminator about the size of the light carrier of a bronchoscope. This has been of great assistance to me during the past year. The view obtained when the thoracoscopic light is turned off and the pleura lit only by the transilluminator is extremely interesting and gives one an entirely new picture of the pleural boundaries and contents. Spacial orientation, the bugbear of the beginner, is made easier. The thoracoscope with its own light is rather similar to a man entering a small wood carrying a lantern in his hand. With the separate and far-away transilluminator light, the view obtained

is similar to that of a man walking towards one in the same wood with the trees thrown into bold relief. This little transilluminator has the same arc as the curved Jacobaeus cautery.

I have applied the silver clips in two separate cases eleven months ago, putting four clips in one and seven in another. Both patients are well today with no fluid and a good collapse of the lung. Neither has any subjective complaints and one is working. The maximum amount of immediate

Fig. 5.—Applying clips. (Actual drawing.)

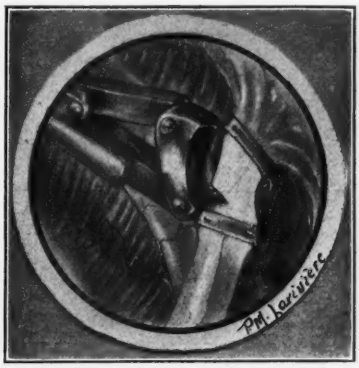

Fig. 6.—Cutting adhesions with scissors.

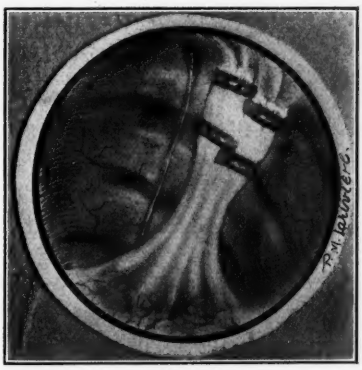

Fig. 7.—Four clips on very broad adhesion.

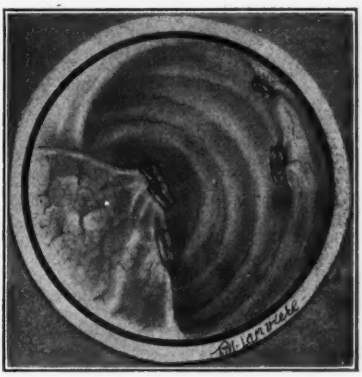

Fig. 8.—After cutting adhesions.

postoperative pleural effusion was 150 c.c. in one case and 25 c.c. in the other. This fluid did not reform after one aspiration. One patient was inspected with the thoracoscope ten days after the application of the clips, and they were seen to be already imbedded in a little mound of noninflammatory exudate so as to be almost lost sight of, resembling little particles of chicken in aspic. The x-ray film showed no haze about the clips indicating a reaction or localized pleurisy. Our experience with Cushing's silver brain clips on the pleura and periosteum applied to control hemorrhage in

thoracoplastic and other operations and also the experience with metallic foreign bodies, such as bullets, in the pleural space, would seem to indicate that they cause little or no harm, their fate being to be finally inclosed in a firm fibrous capsule.

It must be clearly understood that I am not advocating the use of these clips to control hemorrhage in the closed method of Jacobaeus, as the elec-

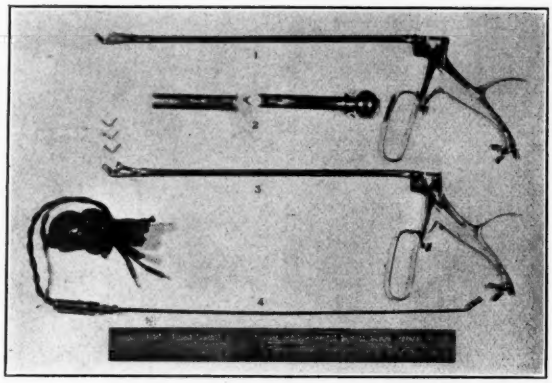

Fig. 9.—The author's intercostal trocar and cannula. Clip applicator, clips, scissors, and transilluminator.

Fig. 10.—The author's transilluminator for use with the Jacobaeus-Unverricht thoracoscope.

trocoagulation, on one hand, and the "cold" galvanic cautery on the other, are simpler and more universally applicable. I am presenting these two cases as being possibly of some interest from the point of view of a new technic only.

The funds for this work were furnished by McGill University and the Royal Victoria Hospital, and the instruments were made by Pilling and Son Company, Philadelphia, Pennsylvania.

FLANGED TELESCOPING DRAINAGE TUBE FOR EMPYEMA THORACIS*

C. M. VAN ALLEN, M.D.
PEIPING, CHINA

THE tube has been used with satisfaction in the treatment of 23 cases of empyema in the acute, subacute, and chronic stages where the cavity to be drained was of considerable size. Both nonspecific and tuberculous empyemas were included among the cases. The chief virtue of the tube lies in the fact that when in place the inner end stays flush with the parietal pleura, insuring it against touching the lung and thereby becoming obstructed, hindering pulmonary reexpansion, or ulcerating the lung. Also by reason of the flanges, the tube is self-retaining and cannot fall accidentally into or out of the chest; and by reason of the telescoping action it is adjustable accurately to the thickness of the chest wall in each case. The bore is large enough to make stoppage from fibrin plugs unlikely and to permit two-way flow of fluids during irrigation of the empyemic cavity. Unlike other flanged tubes for this use known to the author, it is soft and moulds itself readily to the shape of the wound, so that it is comparatively comfortable to wear. A tube can be used for one case only, but it is inexpensive. It can be made by any competent rubber-smith.†

The tube is composed entirely of live, pure-gum rubber 2 mm. in thickness. It consists of two separable parts (Fig. 1, A): an inner tube 1.7 cm. in internal diameter and 7 cm. in length which carries a flange at one end 1 cm. wide, and an outer tube 1.5 cm. in length which fits snugly over the other and carries a flange at the center 2 cm. wide.

The routine treatment of postpneumonic empyema in this clinic requires drainage of three different types used consecutively: intermittent aspiration by needle-puncture, during the period of early formation of pus and prevalence of severe cardiorespiratory symptoms; continuous aspiration through a mushroom-tipped catheter inserted airtightly between the ribs, during the period of subsidence of respiratory symptoms and stabilization of the lung and mediastinum; and continuous drainage through an open tube of larger size inserted after resection of a rib, during the remainder of the period of pulmonary reexpansion. The first measure is sometimes omitted. The third is instituted usually when fibrin begins to separate from the pleurae and obstruct the catheter, about fourteen days after the appearance of pus, and it employs the tube described here. The tube is inserted as follows.

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*From the Department of Surgery, Peiping Union Medical College, Peiping, China.
Received for publication, May 28, 1932.
†The tube is made by Mr. Ta Chang, 41 Tung Tan San Tiao, Peiping, China.

Under local anesthesia an incision about 5 cm. long is made over the rib to be resected, either parallel or at right angles to it. (The latter direction is favored, since it more readily permits of lengthening for approach to ribs above or below when that is necessary, and since it allows the soft tissues to slide down when the arm is lowered to the side at the end of operation, without making the drainage-tract oblique.) About 5 cm. of the rib is resected subperiosteally and the bed of the rib is incised longitudinally to open the empyemic cavity. If it is found that the opening into the cavity is too high, additional resection is done below, sometimes of the next rib but usually only of the intercostal muscle-bundle. The empyemic cavity is emptied of contents, especially of masses of fibrin that may be present, the walls are inspected for adventitious lesions, and the parietal pleura is

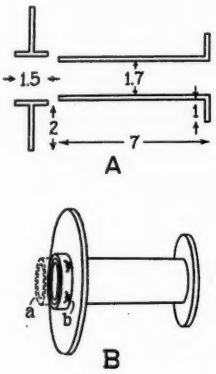

Fig. 1.—A, longitudinal section of both parts of the tube, giving dimensions in centimeters. B, appearance of the tube when assembled as in use. The dotted portion (*a*) of the inner tube is trimmed off and the two parts are held together with several sutures (*b*).

biopsied. The drainage tube is taken apart and the inner tube is inserted, so that the flange lies on the parietal pleura and the other end protrudes externally. The outer tube is then applied and telescoped onto the protruding end until its flange rests on the skin. The portion of the inner tube which extends outside the outer tube (Fig. 1, B, a) is trimmed off, and the two tubes are fastened together by three or four mattress sutures of silkworm-gut or heavy silk (Fig. 1, B, b). The arm of the patient, which until this is usually drawn forward, is now returned to the side and whatever parts of the cutaneous wound that then extend beyond the periphery of the external flange are closed by suture. Gauze dressings are applied (none of them under the flange) and held with a binder.

Postoperative irrigation is carried out by inserting the irrigating nozzle through the tube and letting fluid flow in and out of the chest simultaneously until the returning fluid is clear. Sometimes the tube becomes com-

pressed at the sides, and then a stiffer tube of the same length and guarded by a safety pin is inserted in its bore to maintain patency. The tube is worn until the lung is entirely expanded. By that time the channel is well lined with insensitive granulations, so that the tube can be pulled out almost painlessly. The wound closes rapidly.

Department of Reviews and Abstracts

Conducted by Duff S. Allen, M.D., Associate Editor

Selected Abstracts

Briscoe, C.: The Mechanism of Inflation of the Lungs. Lancet 2: 513, 1931.

No agreed opinion about the production of postoperative pulmonary collapse is at hand, nor is there any clear distinction of the various conditions which have been found and have been included under collapse. Among them are: (a) simple deflation in which the lower part of the lung is more or less airless but in which there may be no symptoms; (b) simple deflation with secretion in which there is bronchial irritation with consequent mucous or mucopurulent secretion; (c) massive collapse attack in which one or both lower lobes of the lungs are found to be airless, with an acute onset; and (d) massive deflation of one lung. The types of simple deflation are very common, but they have been neglected, attention being centered on the two rare conditions and their possible explanation. Simple deflation is not merely very frequent, but it is the basis of all the other deflation conditions.

Two normal anatomic and physiologic facts exert constant influence in the production of deflation, i. e., (a) elasticity of the lung and (b) the minimal use of the lung at rest. This well known and obvious fact akin to the reserve power of the heart has not been sufficiently stressed. It has been shown that when changing from the upright to the supine position the volume of the chest is reduced by 10 per cent to 20 per cent, that in the intermediate position of reclining at an angle of 45° a reduction of 15 per cent in the total volume of the lung ensues. The reserve air is reduced under similar circumstances by about 1200 c.c. The vital capacity of the thorax is markedly diminished from 8 per cent to 80 per cent when tested during the period from two to eighteen days after operation. A logical deduction can be made that on assuming the supine posture a diminution in the intrathoracic volume takes place immediately and that such diminution is continued for some time. In these circumstances the volume of the lung is decreased. Such a diminution might occur equally in both lower and upper lobes or in either one or the other. Such a diminution in one lobe would necessitate an overinflation in the alternate lobe. Measurements indicate that when assuming the supine posture the transverse and anteroposterior dimensions of the upper part of the thoracic cavity are increased while the vertical measurement is diminished. The net diminution of capacity occurs at the expense of the lower part of the thoracic cavity and more at the back than anteriorly. The lower lobe becomes deaerated, deflated, and the upper lobe remains aerated or even hyperinflated so long as quiescence and the recumbent posture persist. These circumstances cause deflation of the lower lobe.

Pathologically the appearance of deflation appears in varied lesions. Ordinarily the appearance of simple deflation of the lung has escaped attention largely owing to the fact that in the routine postmortem the trachea is not obstructed before opening the thoracic cavity. When the trachea is properly blocked, alteration in the relative size of the lung is readily noticed. All stages of deflation may be found. In most bed patients it occurs to a greater or lesser degree. Antemortem edema obliterates the evidence, or the picture may be modified by injury or disease. However, when death has occurred suddenly, the condition may be more clearly seen. In patients dying in coma,

when there has been absolute recumbency for some time before death, the lower lobes are usually found deflated without any obstruction in the bronchial tree. In patients seen a few days postoperative, usually marked deflation of the lower lobes with hyperinflation of the upper lobes without bronchial obstruction is found. In spinal cord lesions lower lobes are more completely deflated than in any other condition without obstruction to the bronchi. In unilateral phrenic paralysis there is observed (a) a considerable degree of deflation of the lower lobe on the affected side, (b) a fully inflated lower lobe on the sound side, (c) a considerable degree of deflation of the upper lobes, more on the affected than on the unaffected side without obstruction to either the upper or lower lobes. The above explanations show that under conditions of respiratory activity reduced to a minimum by posture or weakness, a defect of expansion of the lower lobe occurs. When correlated, one constant factor emerges: the lateral part of the diaphragm beneath the deflated lobe or lobes is elevated. In adults deflation is marked in the course of thirty-six hours; in children it is often detectable in one-half an hour. The signs can disappear readily if diaphragmatic inspirations are taken. When quiescence is resumed, deflation promptly occurs. It is more accentuated when the costal margin is unstable as the result of lack of action of the abdominal muscles as may occur postoperatively. The fundamental cause is the reduction of the necessity for a large air intake, and it is not necessary to postulate any other causal fact. It occurs in all individuals who recline in one position without exerting themselves.

The influence of deflation on postoperative conditions must be regarded as of primary importance upon which further changes are implanted. Simple inflation usually causes no detectable symptoms. However, it may merge into simple deflation with secretion in which there is expectoration of mucus which may be a bronchorrhea. If bacteria act pathogenically, the secretion becomes purulent, and inhalation of the infected material into the deflated lung consequent on deeper respiratory movements gives rise to various conditions of bronchitis, bronchiolitis, bronchopneumonia and pleurisy. The bronchus may be infected before, during, or after operation.

Concerning the etiology of the massive pulmonary collapse attack, two theories have been in the foreground: first, the original theory which ascribed the condition to a reflex paralysis of the respiratory muscles, and second, the theory that the condition is a direct result of obstruction to the bronchi. The obstruction may be due to mucus, spasms or paralysis of the respiratory muscles. Each of the theories evades recognition of the physiologic condition in the lungs found in the resting patient in the early postoperative days, but one assumes that the lungs are in the normal inflated condition. Points requiring explanation are the suddenness of the attack, its duration, the pain and pyrexia. Concerning reflex paralysis as the etiology of massive pulmonary collapse, it is noted that the physiologic lack of distending muscular power is the basis of deflation, but this theory cannot explain the pain and pyrexia. Concerning the theory of bronchial blockade, it is difficult to see how a large bronchus can be occluded by muscle spasm, and it does not explain the constancy of the deflation of the lower lobe, the irregularity of its distribution in the lower lobe, the rarity of its extension to the upper lobe, and the frequently observed deflation with secretion in the absence of bronchial obstruction. None of the theories heretofore given take cognizance of the fact that the massive collapse attack comes on a day or so after operation and is therefore implanted on the condition of the lung existing at the moment. This is shown to be one of deflation affecting both lower lobes without temperature or pain. In the author's opinion these massive collapse attacks are really instances of acute pleurisy occurring when the lower lobes of the lungs are already in a condition of simple deflation. The reasons ascribed for this are (a) the frequent coincident pleurisy, (b) the spasm of the lateral respiratory muscles, such as occurs in pleurisy, (c) the sudden onset of pain, (d) the duration of pain being from thirty-six to forty-eight hours and the relief with thoracic restriction which is comparable to relief experienced with pleurisy. The

pleurisy would explain the temperature and the physical signs. The massive collapse attacks are thought by the author to be instances of well marked simple deflation in which the condition is suddenly modified by the onset of acute pleurisy. The author does not believe the action of bronchial obstruction to be important. He is led to believe that with this conception of the basal physiology of the condition the administration of CO_2 to induce deep inspiration and turning the patient on his side are not advisable because the promotion of deep breathing has the likelihood of carrying infection to the deeper parts of the lungs. In conditions of simple infection as long as the patient is quiescent there is no need of full expansion of the lung. It is unnecessary to adopt any routine measures which aim at promoting once or twice a day expansion of the lung accompanied by fatigue and distress. In simple deflation with secretion the condition may be made worse if the infection is aspirated to the very surface of the lung and pleurisy results. Further, when therapy to expand the lung has been employed, directly it is discontinued the lung proceeds to deflate, a progress only broken by the cough and next therapeutic application. In the massive collapse attack forced expansion will not improve the condition which arises by spread to the surface from the deeper parts of the lung causing a pleurisy over the deflated lobe. The author strongly deprecates methods aiming at expansion of the deflated lung in the early stages after operation and recommends rather (a) sitting up postoperative posture, (b) avoidance of constructive upper abdominal bandages, (c) encouragement of movements of the patient in bed, (d) promotion of ease of expectoration.

Prophylactic measures include avoidance of operation in cases of upper respiratory infection, however mild, and strict measures to preclude air-borne infection during the course of anesthesia and postoperatively. *Maurice Berck.*

Denk, W.: Ist die Phrenikotomie bei nicht tuberkulösen Bronchiektasien augezeigt? (Is Phrenicotomy Indicated in Nontuberculous bronchiectasis?) Wien. Klin. Wchnschr. **45**: 755, 1932.

Paralysis of the diaphragm results in relaxation of the lung and in a lesser degree compression of the lower lobe. Bronchiectasis is a chronic process in which peribronchitis and secondary induration play an important rôle. As phrenicotomy does not suffice to collapse the bronchiectatic cavities, it generally does not influence the disease. There are exceptions to this rule. In early basal bronchiectasis due to fibrosis of the lung, relaxation of the lung may arrest the progress of the disease. Early peribronchial abscesses may be favorably influenced by phrenicotomy in cases in which hemorrhages play a part and in which the source of the bleeding is located in the lower part of the lung. *H. A. Carlson.*

Houghton, L. E.: The Influence of Gold Salts on the Hemogram in Pulmonary Tuberculosis. A Method of Blood Assessment. Tubercle **13**: 385, 1932.

The von Bonsdorff and differential leucocyte count and the sedimentation rate of erythrocytes are used to determine prognosis and the effect of gold therapy in pulmonary tuberculosis.

Based on the work of Medlar, Doan and Sabin, and others, a formula is devised from the differential leucocyte count to express the status of tuberculous infection: P plus M minus 2L where P equals percentage of neutrophiles, M equals percentage monocytes, and L equals percentage of lymphocytes. A high value indicates a bad prognosis, a low value, good. This value added to the sedimentation rate of red cells and subtracted from the von Bonsdorff count gives a figure which represents a summary of the patient's position as shown by his blood picture. A high figure represents a good prognosis, a low figure, bad.

The index obtained in this manner was used to study the course of fifty cases of pulmonary tuberculosis under sanocrysin treatment. Both 0.1 gram and 0.5 gram doses

were injected at weekly intervals. The majority of cases with initial indices over 100 tended to show improvement; those with initial indices below 100 were unimproved or made worse.

The immediate leucocytic reactions to sanocrysin are irregular; although treated cases seem to show two groups of blood pictures; those of patients who ultimately do well and those who ultimately do poorly.

In these investigations equally marked changes in the hemogram were produced by doses of 0.1 gram of sanocrysin as by doses of 0.5 gram.

An early drop in the sedimentation rate sometimes occurred following sanocrysin injection. It is regarded as a favorable reaction.

It is suggested that the action of sanocrysin may be on the blood forming tissue, and that alteration in the blood composition may bring about its effect on tuberculous foci. Those cases with a lymphocytic response are benefited; those with a monocytic response are made worse. *Edward Burns.*

Leimdorfer, A.: Localized Edema of the Upper Respiratory Tract in Nephritis. Wien. klin. Wchnschr. **45**: 1411, 1932.

In nephritis and in circulatory disorders in which edemas are found, edematous swellings are frequently found in the upper respiratory passages. This noninflammatory type of swelling may be overlooked since it developed slowly.

A case is reported illustrating some of the usual features. A sixty-eight-year-old man had noticed for two weeks a difficulty in swallowing and wheezing, salivation, and an uncomfortable pasty feeling in the pharynx. He had had no fever. Inspection of the pharynx showed an edematous uvula and there was a glassy appearance of the glossopalatine arches. There were no signs of inflammation and because of this Leimdorfer thought that the localized edema might be due to systemic disorder. He considered that this might be either a nephritis or a circulatory disorder.

Further examination revealed that the patient had a hypertrophy of the heart, most marked toward the left and increased blood pressure. The examination of the urine showed albumin, granular casts, casts of red blood cells and free red blood cells. This explained the condition of the pharynx.

The significant feature of such localized edematous areas in the upper respiratory passages is that the edema may suddenly become more marked. If, on account of the insidious onset they have not been suspected, they may lead to suffocation before relief is attempted. Therefore, the pharynx and larynx should be examined in all cases of cardiorenal disease.

Carr, J. G.: The Cardiac Complications of Trichterbrust. Ann. Int. Med. **4**: (n.s.), 885, 1933.

In patients with Trichterbrust there is a displacement of the liver, heart, and the various contiguous organs. There is, first, an enlargement of the antero-posterior diameter of the chest in the mammillary line, second, a very significant enlargement of the transverse diameter and, third, an elongation of the vertical diameter, the liver being situated lower in the abdomen. The sternum is always depressed toward the spine. Usually the most markedly depressed portion of the sternum is at the lower end of the corpus sterni. Sometimes the distance between the posterior surface of the sternum and the anterior margin of the vertebrae is only 1 cm.

The heart is usually displaced to the left, often lying entirely within the left chest. There may be a simultaneous rotation of the heart about its own sagittal axis. Thus the normal systolic-diastolic change of form and rotation is rendered difficult. The position and form of the venous openings into the heart may be changed also.

The disability does not correspond to the deformity. In von Fleisch's patient the depression was extreme; nevertheless, there had never been any respiratory pains and he could do hard work without dyspnea. In certain patients the associated *habitus asthenicus* may account for the symptoms of circulatory embarrassment. In these, surgical treatment of the deformity is contraindicated.

The first operation for correction of the symptoms due to the deformity was performed by Ludwig Meyer in 1911. This operation was not successful. More extensive resection of the costal cartilages and portions of the ribs in other patients, however, have proved the worth of surgery in selected cases. Zahradnicek perforated the sternum and introduced two wires to which traction was applied.

The two cases of traumatic rectus excavatum reported by Alexander in 1931 are reviewed. In the first case, a boy of sixteen, the depression of the sternum had followed an injury sustained while wrestling. He had dyspnea and occasionally dysphagia. The sternum was held elevated by traction after section of the cartilages. The second case was a woman of twenty who had sustained an injury in an automobile accident. She had severe pain in the region of the heart radiating to the left shoulder, palpitation and dyspnea. Both of these patients were relieved of their symptoms.

Carr reports an additional patient with Trichterbrust who had a rapid heart beat, faintness and dyspnea. She was operated upon by Dr. Jerome Head who removed the 4th, 5th, 6th, and 7th costal cartilages on both the right and left sides and the lower half of the sternum and xyphoid. The symptoms were relieved. A second case mentioned upon whom a similar operation was performed died within 48 hours following the operation.

Only patients in whom the symptoms may reasonably be attributed to the deformity should be considered as candidates for operative interference.

Berry, Frank, and Childs, E. P.: The Fissures of the Lungs, 96: 961, 1932.

The purpose of this study was to outline an exact anatomical method for locating the boundaries of the various lobes of the lungs.

The interlobar fissures are a series of concavoconvex surfaces meeting at the hilus. In addition the surfaces of the great fissures are twisted upon themselves. The main fissures reach the back near the level of the spine of the third thoracic vertebra. On the left the level proceeds forward across the axilla at the level of the 4th rib and from there to the 6th costal cartilage. On the right, the principal fissure crosses the axilla slightly lower than on the left—at the level of the 5th rib—and from there forward to reach the costochondral junction of the 6th rib. The two main fissures, therefore, divide their respective lungs into two almost equal parts. On the right the small transverse fissure reaches the chest wall near the level of the 4th interspace in the midaxilla and extends forward almost horizontally. This fissure is notably inconsistent. Not infrequently it is merely a divided portion of the upper.

Detailed descriptions of the various fissures and the phrenic surfaces of the lungs are given.

Four cases with interlobar pathology or pathology of the neighboring lung tissue are discussed. These cases illustrate the importance of definite knowledge of the topographic anatomy of the lungs in respect to diagnosis.

Bronfin, I. D., and Chernyk, M.: The Value and Limitations of Phrenicectomy in Advanced Pulmonary Tuberculosis. Am. Rev. of Tuberculosis **26:** 689, 1932.

The results of phrenicectomy in 183 cases is the basis of this report. The evolution of this operative procedure along with the basis for its effect on pulmonary tuberculosis are discussed and its indications defined.

In tabulating their results the authors have gone into considerable detail in classifying and grouping their cases. They lay great stress on the necessity of this in order to obtain a correct evaluation of the statistics obtained. For example, they point out that moth-eaten, and thin-walled cavities are more apt to respond to this form of therapy than chronic, rigid, thick-walled cavities. Also such factors as region of involvement, multiplicity of cavities and whether the lesion is unilateral or bilateral will have a very considerable influence upon the results of treatment.

A composite summary follows: 29 (15.8 per cent) of 183 patients, acquired an arrest of the disease. However, in 17 of these other measures were employed, thus, only 12 (6.6 per cent) acquired arrest from phrenicectomy alone. Seventy-one (38.8 per cent) were improved. Of these, 41 (57.7 per cent) were restored to full time work for periods from six months to five years. Sixteen (22.5 per cent) were able to do part time work, the remainder were under observation or ambulant. Twenty-six of the 183 (14.2 per cent) remained stationary while twenty (10.9 per cent) became worse, either through progression of the disease or development of complications.

There was no immediate operative mortality. Two (1.1 per cent) died within one month, and six (3.3 per cent) within two months after the operation but no clinical evidence suggested the operation to be a contributing factor to this mortality.

Improvement, both generally and symptomatically, was noted in the above 71 cases. There was gain in weight and strength with diminution in cough and sputum.

The authors believe that the widest field of usefulness of this procedure is in predominantly unilateral lesions with little or no cavitation when pneumothorax is impossible and when beneficial results are not obtained by routine sanatorial regimen. It also is of value in bilateral cases which have a limited contralateral lesion without definite cavitation. Its use in checking hemoptysis is variable and other therapeutic measures should be tried first. It frequently is of definite value when used in conjunction with pneumothorax. Its usefulness is limited and generally contraindicated in chronic lesions with bilateral cavitation, associated with emphysema and general debility. W. E. ADAMS.

Eliason, E. L., and McLaughlin, Chas.: Postoperative Pulmonary Complications. Surg. Gynec. Obst. **55**: 716, 1932.

This statistical study was based upon 7,326 general surgical operations exclusive of gynecological, urological, neurosurgical or otolaryngological cases. It also was confined to one unit of the hospital, service C, where conditions were comparable at all times. Pulmonary complications were defined as those demonstrable by physical signs or by an x-ray, which occurred between the time of operation and discharge from the hospital.

The study was made on operations performed between 1922 and 1931. Of 7,326 operations 120 postoperative pulmonary complications arose resulting in 39 deaths. This is a morbidity of 1.68 per cent with a general mortality of 0.54 per cent from this complication. Of those developing pulmonary complications 32.5 per cent resulted in death.

From postmortem examination it was apparent that in 8.35 per cent of the total operative mortality, death was due entirely to the pulmonary complication and that 15.5 per cent could be at least partially attributed to this complication.

Postoperative pulmonary complications with theories as to etiology are discussed. The type of anesthesia is considered and found to have little influence on the percentage of complications although the number of complications increases with the length of anesthesia up to 1 to 1½ hours.

Upper respiratory infections existing at the time of operation were found to be

a definite factor influencing postoperative pulmonary complications, 19 to 120 falling in this category with 10 deaths, directly due to this complication.

Pulmonary complications were more prone to follow operations on the stomach, duodenum and jejunum with gallbladder and appendix following closely behind.

The complications occurred more frequently on the third or fourth postoperative day, with the mortality highest between 24 and 48 hours. They were more frequent between the months of November and March and 70 per cent occurred in male patients. Blood pressure changes and morphine administered postoperatively had little influence on their appearance.

The above figures were found to agree essentially with those of other authors with whom they were compared.

Suggestions for therapy were discussed. As a prophylactic measure, those patients with existing upper respiratory infections should only be operated on in case of emergency.

Carbon dioxide was thought to be of definite value in preventing postoperative atelectasis and its sequelae. Breathing exercises and avoidance of constricting binders about the upper abdomen were thought to be of value.

Prompt symptomatic and specific measures were advised as soon as complications were diagnosed. W. E. ADAMS.

Rentschler, Calvin B.: Acute Empyema of the Thorax. Ann. Surg. **96**: 987, 1932.

This report is based on a study of the immediate and late results of 100 consecutive cases of acute empyema treated between 1920 and 1930. Seventy-five per cent of the cases occurred as a complication of pneumonia. The predominant organisms cultured were the pneumococcus and streptococcus. Forty-six per cent of the cases occurred between three and twelve years of age; 33 per cent over twelve years, and 21 per cent under three years. In treatment of acute empyema, two cardinal principles are emphasized, first, the importance of not creating open drainage too early, and second, conservative treatment in the very sick patient. The open method of drainage was used and in all cases was preceded by aspiration although in most cases this was a diagnostic procedure. In old empyema any procedure short of rib resection is futile. Fifty-eight per cent were done under local anesthesia, 22 per cent under nitrous oxide and 10 per cent under ether. The postoperative treatment consisted mainly of maintaining adequate drainage and supportive measures. Irrigations were not used in 70 per cent of the cases and in the remainder they were not thought to be of definite value. Diet and exercise were emphasized and transfusions were frequently used to combat anemia.

The mortality in this series was 10 per cent. This was highest in the case of streptococcus (20 per cent) and mixed infection (27.27 per cent) and lowest where the pneumococcus (0.0 per cent) was the infective organism. Also the mortality rate was higher under three years of age (14.28 per cent) and over twelve years (15.15 per cent) than between the ages of three and twelve years (4.34 per cent). The average hospitalization period was forty-eight days. Twenty-two patients were discharged with drains still in use and in these the average healing time was two months and three weeks. In 6 of the series there was a recurrence of the empyema and in one of these empyema recurred six times with drainage an equal number of times.

A detailed résumé is given of the 10 cases terminating fatally. Most of these patients died shortly following operation of a profound toxemia.

The above statistics compare very favorably with those of other reports which are discussed. W. E. ADAMS.

Pollock, W. C., and Marvin, H. P.: Bilateral Artificial Pneumothorax. Am. Rev. of Tuberculosis **26:** 709, 1932.

Bilateral pneumothorax is applicable to a limited group of patients with bilateral pulmonary tuberculosis. The group of twenty-five patients studied by the authors seemed to have a hopeless prognosis without compression therapy.

The prognosis in chronic pulmonary tuberculosis is most accurately indicated by the absence or presence of cavitation. The most important factor in the treatment of pulmonary tuberculosis, therefore, would seem to be "the proper selection of a type of collapse therapy most suitable for the eradication of the cavitation."

Pollock points out that while cavities do heal spontaneously the majority do not. Of 1,454 cases studied by Barnes and Barnes 80 per cent died within one year, 90 per cent died within five years and the average duration of life was 15.8 months. Of 626 cases with cavitation studied by Spurgman there was a death rate of 61.7 per cent during the first two years. The presence of a cavity, therefore, is a serious menace to the patient's life.

A cavity of 2 by 3 cm. should be collapsed even when there is easily demonstrable disease in the opposite lung. Collapse therapy should not be delayed, especially if pneumothorax is the therapy of choice, since adhesions may form between the visceral and costal pleurae. Bilateral lesions in which collapse measures were once considered as prohibitive are now considered for collapse therapy with the resultant prolongation of life and in certain cases arrest of the disease.

Patients with bilateral involvement of the lungs may be divided into three groups (1) very extensive bilateral involvement, with or without cavitation, in which a complete unilateral collapse is contraindicated. Bilateral pneumothorax with incomplete collapse is indicated. (2) Bilateral cavitation with slow progress of the lesions and with fibrosis of parenchymal lesions. Collapse therapy here is to close the cavities. (3) Extensive bronchogenic spread or activation of the process in the contralateral lung after the institution of unilateral pneumothorax. In this event, the contralateral lung should be collapsed also usually by a small pneumothorax.

An analysis of the twenty-five cases indicates (1) advanced bilateral lesions may be arrested by bilateral pneumothorax, (2) bilateral cavities may be closed, (3) rapid fatal termination from bronchogenic spread to the opposite lung may be avoided by early selective pneumothorax, (4) collapse therapy may be used to advantage even in patients with extensive involvement of both lungs.

Leslie, G. L.: Collapse Measures for Pulmonary Tuberculosis—A Study of Their Relative Applicability. J. A. M. A. **100:** 313, 1933.

A study was made of 420 consecutive patients admitted at the Michigan State Sanatorium. Of these 5.5 per cent were classified as having minimal tuberculosis, 28.2 per cent were moderately advanced and 66.3 per cent were far advanced.

Of this series 77.14 per cent were selected for some type of collapse therapy. Of those patients receiving collapse therapy, artificial pneumothorax was given to 57.38 per cent, phrenic nerve surgery was performed in 56.6 per cent (two-thirds of these had permanent nerve interruption), and 18.86 per cent had either thoracoplasty, extrapleural or intrapleural pneumolysis supplemented to artificial pneumothorax and phrenic surgery.

Leslie believes that the percentage (77 per cent) of patients receiving collapse therapy is not too high or that it does not indicate excessive enthusiasm of the staff for collapse measures. He believes that except for the overwhelming and rapidly fatal cases of tuberculosis there are but few cases of unilateral tuberculosis which

should not have some form of collapse therapy. He advises this even with early and minimal infections in order to avoid progression of the disease and to speed and assure the recovery by a more effectual rest of the diseased lung. Bed rest is inferior to collapse therapy in that the period of hospitalization is longer with bed rest and there is less permanent protection.

He concludes that the majority and not the minority of patients with pulmonary tuberculosis are suitable for some type of collapse therapy. Bilateralization of the lesions is not a contraindication. The collapse should be brought about as soon as possible after the diagnosis has been established.

Pollock, Wm. C., and Marvin, Horace P.: Congenital Cystic Disease of the Lung. Am. Rev. of Tuberculosis **27**: 59, 1933.

Attention is called to the rarity of this condition although it is thought to be a distinct clinical entity. In reporting their case the authors express their belief that the condition is secondary to a narrowing of the bronchus and that this narrowing is congenital. The cystic changes are usually confined to one lobe, more frequently the upper and may remain stationary for many months or years without symptoms, and be found accidentally on routine roentgen-ray examination. If more than one lobe is involved continued pulmonary stress and strain cause progression of the disease with resultant symptoms of dyspnea, cough, etc.

The case reported was a man of 40 who had been somewhat short of breath for ten years. His trouble began with chills and fever. His fever subsided in ten days without cough or expectoration. He was referred to authors for treatment of pulmonary tuberculosis. Examination revealed signs of compressed lung over right apex with decreased B. S. and V. F. with hyperresonance over cystic left apex. X-rays confirmed the findings at right apex and revealed a structureless area at left apex with fine curved sweeping lines at its inferior limit. The condition must be differentiated with spontaneous pneumothorax. This is easily done by induction of artificial pneumothorax and obtaining normal intrapleural pressures with an x-ray picture defining the two conditions.

Cases coming to autopsy reveal multiple cavities varying in size. The inner walls are smooth, shiny and greyish in color and interspersed with thin prominent bands. The cysts may be separated by a wall only 1 mm. in thickness.

Two other cases were cited. No suggestions as to therapy were given.

W. E. ADAMS.

Book Reviews

CONTRIBUTION A L'ETUDE DES SUPPURATIONS PULMONAIRES NON TUBERCULEUSES ET EN PARTICULIER DE LEUR TRAITEMENT CHIRURGICAL, by Dr. Etienne Curtillet; Alger, Imprimerie Baconnier Freres, 1932.

This book published from Algiers is an excellent monograph of 350 pages on the subject of nontuberculous pulmonary suppuration. The literature from various parts of the world has been well reviewed and collected in an excellent bibliography of twenty-eight pages. The illustrations for the most part are well selected x-ray films which have been excellently reproduced. Like many other European writers on this subject the author gives scant attention to bronchoscopy and dismisses the diagnostic value of this procedure with one short paragraph in which he states that he has had no experience with it. This would seem to the reviewer to be the most serious defect of the whole work. The use of the bronchoscope as a therapeutic procedure, however, has been given much more consideration, but it is evident that the author relies upon articles which he has read for his discussion of the subject. It is of particular interest to Americans to read that the author does not consider that postural drainage has been of much value at his hands, because many Americans feel that this simple procedure is of very great value. The author states that he agrees with Hedblom in the value of phrenicectomy for bronchiectasis, especially in recent unilateral cases and even in old cases he considers it to be so simple and so free from drainage that it is well to undertake it. He thinks the procedure is of particular value in basal lesions. It is surprising, however, that he has apparently had no experience with bad effects from phrenicectomy in such cases. Several methods of lobectomy are very well discussed, including Lilienthal's and Brunn's, but no mention is made of Shenstone's or of Alexander's. The author also gives considerable space to a discussion of Graham's operation of cautery pneumectomy in multiple stages with its modifications by Coquelet and by Baumgartner. He expresses the modern note in stating that a collaboration between physicians and surgeons is very necessary in the proper handling of pulmonary suppuration. He thinks also that special medical and surgical services should be created in the large centers for a handling of these conditions, arranged in such a manner that there will be frequent examinations and discussions of the cases by the medical and surgical members of the group. A very interesting section of the book contains an historical summary of our knowledge and methods of treatment of these conditions. The questions of etiology and pathogenesis, the pathologic anatomy and

clinical features are all discussed in a very satisfactory manner. One helpful feature to the reader is that each subject is summarized at the end in a paragraph in italics.

CLINICAL ROENTGEN PATHOLOGY OF THORACIC LESIONS, by William H. Meyer, illustrated with 183 engravings, Philadelphia, 1932, Lea and Febiger.

This book of 261 pages and 183 illustrations is an excellent summary of our knowledge of the roentgen pathology of the thorax.

Although there is an abundance of reproductions of roentgen films, there are many other illustrations which are diagrammatic. These latter are particularly instructive. There is almost no reference to the literature, since the book is not intended to be an exhaustive work of reference. It will be found helpful to any one interested in thoracic disease and not alone to the roentgenologist. The first section of the book concerns itself largely with a discussion of technic of both fluoroscopy and the taking of films in proper positions. The rest of the book deals for the most part with the interpretations of various thoracic lesions.

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Sixteenth Annual Meeting of the American Association for Thoracic Surgery

Washington, D. C., May 9, 10, and 11, 1933.

THE sixteenth annual meeting of the American Association for Thoracic Surgery will be held in Washington, D. C., on Tuesday, Wednesday, and Thursday, May 9, 10 and 11, 1933.

Three foreign collaborators have been invited to read papers before the society. At the present writing one of these, Mr. Tudor Edwards, has accepted the invitation. This should add materially to the program.

Hotel headquarters will be the Willard Hotel. You are requested to write for reservations either direct to the manager of this hotel or to Dr. James F. Mitchell, 1344 Nineteenth Street, Washington, D. C.

At the present time the program for the meeting is not complete. Requests for papers were sent to the members only two weeks ago. The response this year has been better than in the previous four years. The following is a draft of the tentative program.

Preliminary Program

1. "President's Address." Dr. George P. Muller, Philadelphia.
2. "An Estimate of the Value of Phrenic Nerve Interruption Based on 650 Cases." Doctors John Alexander and Lawrence Nehil, Ann Arbor.
3. "Selective Surgical Collapse for Lung Abscess." Dr. Richard H. Overholt, Boston.
4. "Operative Mortality from Thoracoplasty in Pulmonary Tuberculosis—Study of 6 Cases." Dr. H. L. Beye, Iowa City.
5. "Treatment of Traumatic Hemathorax, an Experimental and Clinical Study." Doctors D. C. Elkin and J. C. Sandison, Atlanta.

6. "Respiratory Efficiency as Determined by CO_2 Retention in the Blood Stream." Dr. Ethan F. Butler, Elmira, N. Y.
7. "Collapse Therapy and the Ambulatory Patient." Dr. J. A. Myers, Minneapolis.
8. "Bronchiectasis." Dr. James A. Miller, New York City.
9. "The Results of Phrenic Nerve Operations in 250 Cases With a Discussion of the Technique of the Operations." Dr. H. Ryerson Decker, Pittsburgh.
10. "Experimental Study of the Effect of Phrenicectomy on Cough." Dr. Herbert A. Carlson, Minneapolis, Dr. Harry C. Ballon, Montreal, Dr. Hugh M. Wilson and Dr. Evarts A. Graham, St. Louis.
11. "Carcinoma of the Bronchus." Dr. Louis H. Clerf, Philadelphia.
12. "Closed Intrapleural Pneumolysis. A Critical Review." Dr. Julian A. Moore, Asheville, N. C.
13. "Pneumocavernolysis in the Treatment of Pulmonary Tuberculosis With Cavitation." Dr. Harold Neuhof, New York City.
14. "Pneumonectomy for Carcinoma of the Lung in a Tuberculous Patient." Dr. Howard Lilienthal, New York City.
15. "A Gram-negative Anaerobic Bacillus—Its Pathogenic Significance in Putrid Lung Abscess." Dr. John Cohen, New York City.
16. "The Surgical Significance of Some Aspects of the Gross Pathology of Pulmonary Tuberculosis." Dr. Maurice Berck, New York City.

The above program is subject to change. Several papers will be added and in certain instances the authors have reserved the right to withdraw their title or to substitute another paper.

The final program will be published in the April issue of THE JOURNAL OF THORACIC SURGERY.